ILLUMINATING ENGINEERING

JULY 1955

Featuring

Environment in Seeing
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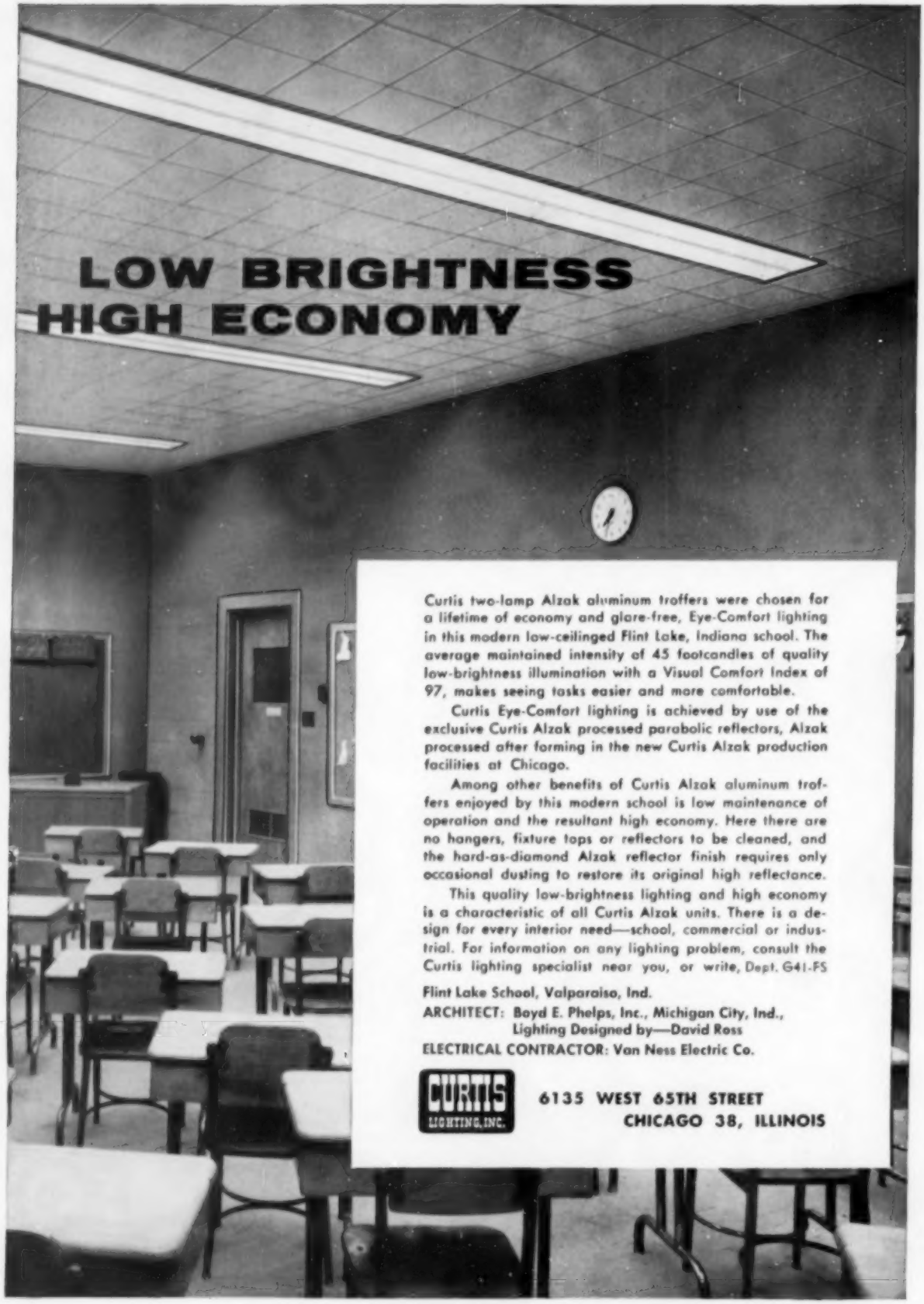
THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY



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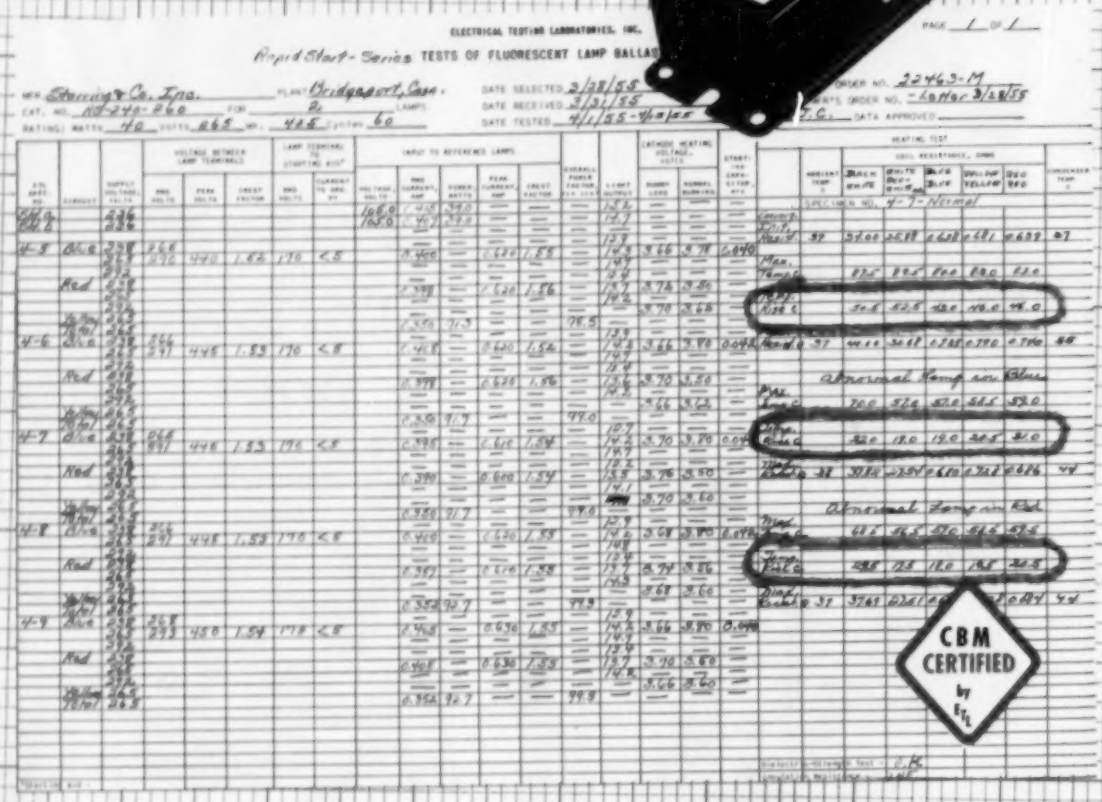

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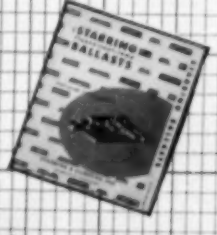

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Environment In Seeing

By L. C. KALFF

PER DEFINITION we understand environment to be all the things that we see around the visual task in the human visual field. There is no doubt that our visual environment influences our visual comfort so that it can cause sensations of discomfort and of comfort. It seems necessary to give also a definition of seeing comfort.

We can start by saying that it is certainly not the absence of discomfort and that we believe that seeing-comfort is a positive sensation. Psychologists know that there are very many grades of pain; the lowest grade being unbearable pain, and then there are just bearable pain, disturbing pain, hardly perceptible pain, then we come to zero the absence of pain, but the line continues and certain sensations of pain may cause even some pleasure or lust. We should like, when thinking of seeing-comfort of a similar scale where, as Hopkinson did for the sensation of glare, the conditions of seeing can be described as unbearable, just bearable, disagreeable, not very agreeable, neutral and then start being comfortable and even giving pleasure. This comfort or pleasure is not dictated by visibility; it is a matter of cause that for comfortable seeing there should be the correct lighting level, that the amount and quality of shadows and the color of light be in harmony with the shape and color of the seeing task, but comfort asks for other and more factors to be fulfilled before we can consider it to be achieved. We can mention some of these conditions without being sure that we are being complete.

In the first place the seeing task must ask our attention by being the most obvious thing in the visual field. In the second place for normal work concentration on the object must be possible, that is environment must be such, that not only we are not disturbed by other too interesting spots in the visual field, but also lines, colors and luminances should contribute to the concentration on the visual task. Then there should be the factor of attractiveness. Attractiveness again is a positive factor; it is not the absence of ugliness but it is a certain harmony in proportions in colors and in lines and brightnesses. It is this attractiveness that will give us seeing pleasure. We are not sure that a further step towards seeing-comfort would be beauty; it may well be that the judgment of beauty would be in the first place too individual to give an indication in what direction to go, but also beauty is not a sensation which we can undergo for a very long time staring at the same object. It might well tire us and deviate us from the comfortable observation of the seeing task we have to look at during our work.

All these conditions for comfortable seeing can only be realized or influenced by three factors, that together compose the whole of the visual field. These factors are lines, colored surfaces and brightnesses. We believe that working schemes for the interior decorator and the lighting expert can be derived from observations concerning these three elements, working schemes which will enable us to create the environment which will give us the conditions for comfortable seeing. We have first published our observations in this direction in our Stockholm lecture in 1951 for the C.I.E.

Attractiveness and beauty can of course only be achieved by artists who, conforming to the given working scheme, compose a visual field that is satisfying in all respects. We want to stipulate here that though we can find in many works of art the same fundamental rules of composition these rules do not necessarily lead towards a work of art if they are handled by the layman, and it also may be necessary to say that the object of the artist making a work of art will not necessarily be a creation of visual comfort for the observer.

We will now come back to the three elements, lines, colors and brightnesses that compose the visual field. It will be obvious that lines can concentrate our attention on a certain point. They can also diverge, lead our eyes in a certain direction, can distract us from the essential part of the visual field and can be chaotic so that our eyes by the lines in the picture have no guidance at all. Let us look at the interior of a high Gothic French cathedral. All the lines of the hundreds of slender

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 14-17, 1954, Atlantic City, N. J. AUTHOR: General Art Director, N. V. Philips Gloeilampenfabrieken, Eindhoven, Holland.

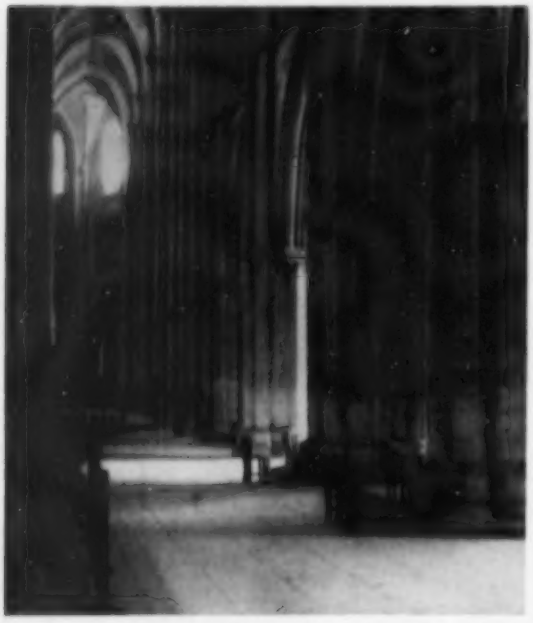


Figure 1. The vertical lines cutting the visual field in vertical zones, with the shadows between the columns so that the highest brightness is found at the end of the church, illustrate the tendency to accentuate by lines and shadows the direction in which to guide the eyes.

Figure 2. (below) In comparison to the vertical lines in Fig. 1 the curved lines in this monastery limit the direction of the eyes to an almost horizontal one, making it difficult to look upward.

Figure 3. (below right) The horizontal lines in this big office have a tendency to keep the attention focused on the desk and the work.

pillars, of the Gothic arches strive upward in an almost endless repetition of the vertical so that involuntarily our eyes are guided and are drawn upward leading our mind to think of higher things.

A vaulted low hall in a monastery of the Cistercian monks in France leads the occupants to look down, reading their books, studying their manuscripts, taking their meals. The round lines of the arches limit the visual field by a strong accent which make it almost impossible to look up. Still the arches in this hall give more space to human fantasy than a completely horizontal and flat ceiling in the big American office. There, the only place on which one can concentrate with any pleasure is the desk with the visual task on it, but I think everybody will agree that the attractiveness of the more spacious hall in the monastery can never be obtained in a big office space.

The lines, converging at the horizon of a long road make us concentrate involuntarily on the end of the road. We are fascinated by that little spot of bright sunlight towards which all the lines of the curb, of the trees and of the border of the road point. If this were not our natural reaction many more accidents would certainly occur in traffic.

The study of colors in our environment is a very difficult one since we generally feel comfortable amidst soft and subdued hues and tints and certainly can not bear big surfaces of saturated colors.

Now in general studies of colors have been carried out in connection with color systems like Oswald's or Munsell's where contrasts and harmonies are derived from the spectral colors, arranged in circles and where only saturated colors are considered. In the first place this does not teach us anything of real value for our environ-

ment since the colors we use there are of a completely different character; in the second place these studies are carried out completely apart from the influences of light and brightness which are of such great importance of the visual impression we get of our environment. Then the study of preferences for color are generally carried out with samples all of the same dimensions.

Now in an interior the bulk of the surfaces we see have mostly very subdued colors: think of the natural wood, the much used off-white paint, the many grays and beiges and soft greens we use for walls, carpets and curtains; the accents of a stronger color generally cover relatively small surfaces like a vivid note in a picture on the wall or a bunch of flowers on the table. It will be obvious that, however simply we would arrange our experiments it would be altogether too difficult to obtain results of any value with many persons trying to find generally valid reactions. Since we believe that for the colors in our environment statistical indications of preferences are impossible and since we have to carry in mind that color is only part of the picture and very much dependent on the light that falls on it we must admit that scientific methods for obtaining results will here never do. We believe that practical observations can only be made by the talented creative man who, guided by his sentiments, judges all the scenes he sees, trying to analyze which is comfortable or uncomfortable.

We should only want to make one distinction here between colors in order to be able to go into the matter a little more deeply. We want to call all colors of a longer wavelength warmer in respect to those of a shorter wavelength.

We personally firmly believe that colors of similar saturation and intensity can be compared in this sense and that for the great majority of observers the warmer colors have more attraction for the eyes than the cooler or more neutral ones, but we have not, up till now, been able to prove so experimentally in a convincing way. We have asked many questions on the subject and mostly the answers were satisfactory to us. But we must admit that it is extremely difficult, if not impossible, to get incontestable results in the scientific sense with this class of colors.

We must see the things as they are. If we want a workable method for creation of comfortable environment for our eyes, scientific, technical, psychological and artistic working methods will have to be used together in order to get results, because none of the arts separately will yield any acceptable results. Now I am personally building a theory on the assumption I have just mentioned. If we

Figure 4. All the lines in this picture indicate the visual center which is situated at the end of the road.

want to keep our eyes concentrated on a visual task we will have to try to find a climax of attraction, from the background in the visual field to the immediate surrounding of the visual task and from there to the task itself. If for the majority of the observers what we have assumed is right, the cooler and more neutral colors should be near the outer edge of the visual field, that is in the background and colors becoming gradually warmer should be used the nearer we come to the visual task. Thinking in this way it is obvious that for reading, a table-top or desk in natural wood is excellent if the floor is a darker brown or gray and the walls are a very quiet blue or green. Actually if we try to reverse the scene, making a green table top and giving the walls a warmer color like pink or yellow or even red there is a general feeling that the atmosphere is not at all fit for concentration on the paper and that the eye is constantly distracted from the task by the warm colors on the walls.

As we have said the third factor of the picture in the visual field is the brightness pattern of it. Here the question is so obvious that we do not think anybody will object to our saying that again the brightnesses in the central field should form a climax towards the task, the task being the brightest object and gradually the surroundings and the background becoming darker. It is obvious to us all that such a pattern of brightnesses can only be obtained by color and light together.

We speak of "high lighting" a thing, put spotlights on artists on the platform and are struck by the beauty of a landscape when the sun bursts

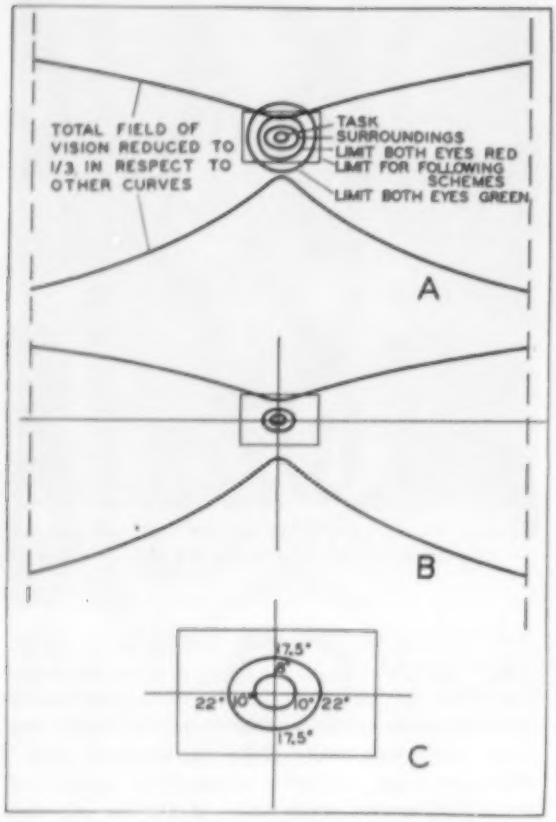


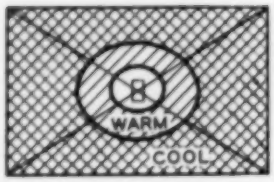
Figure 5a. Part of the solid angle enclosing the visual field of a normal person. The nose, the cheeks and the eye-brows limit this angle.

5b. The seeing task and the immediate surroundings are only a very small part of the total visual field, but they are the most important.

5c. Detail of the visual task and the immediate surroundings with the angles of the conus enclosing these parts of the visual field.

through the clouds and causes a bright center in the picture. We are well aware that the mountains lack their greatest attraction as long as the snowy tops stay in the clouds. We make the dining table important by lighting a lamp over it and laying a white cloth on it; we dress the most important person in a wedding ceremony in white; we are much more interested by a floodlit castle standing against the black sky than by the same building in daytime with a bright sky behind it.

We have endeavored to make line-color-brightness schemes combining the three elements in such a way, that the concentration on the seeing task is easy, that nothing in the visual field distracts us but on the contrary that everything cooperates to take away all the unnecessary strain while we are looking at a certain object. Before we can make



FOR ONE SINGLE TASK (READING)

Figure 6. Lines, colors and brightnesses cooperating for maximum attention on task.

such a scheme it is necessary to examine the visual field somewhat nearer. The visual field as it is projected on the retina of both our eyes is enclosed by a very large solid angle. The impression however, we get from the different parts of the visual field depends very much on the place where the image of what we see is projected on the retina. As you know there is in the retina a blind spot where the optical nerve enters the eye, near that blind spot we find the yellow spot or fovea which gives us the most exact information on brightness and color and lines and which generally is so orientated that it covers the seeing task. Around this fovea we find a surface covered with cones and a few rods and this area is sensitive to all colors. Outside that surface the number of cones gradually diminishes and the sensitivity to color ceases.

Now it is well to know what part of these different surfaces correspond with the different parts of the visual field. We have made for our scheme a division in the visual field which we will explain and which coincides in a remarkable way with the just described different surfaces of the retina. The seeing task generally is enclosed by a solid angle of elliptical section 8 degrees up and down and 10 degrees to the left and right. This angle is easily covered by the movements of the eye, looking at an object with the head in a fixed position. For instance it covers easily the surface of a book at normal reading distance. Then we want to distinguish the immediate surroundings of the eye-task which we should like to describe as a solid angle of 18 degrees upward and downward amplitude and 22 degrees to the left and the right. This is that part of the visual field in which we can still distinguish details and colors without moving the eyes from the seeing task. There is a remarkable correlation between this solid angle of the surroundings and the solid angle outside which we do not perceive red and green, and outside which we do not see any details. The rest of the visual field we think to be of less importance for our study because it will only serve to warn us through sensitivity for movement and brightness contrasts that we should focus our attention on something

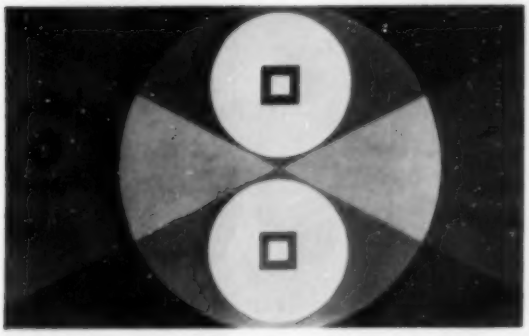


Figure 7. This is a line-color-brightness scheme in which these three elements cooperate to draw the observers' attention either to the work on his desk or in looking up towards another center of interest. The colors in the central circle must be thought to be warmer, that is of greater wavelength than those of the background.

else, but if we avoid excesses in that part of the visual field it does not influence visual comfort very much. It is obvious that a solid angle of this size covers only a very small part of the total solid angle enclosing the visual field, that for instance may extend to the left and the right between 70 and 80 degrees.

If we look constantly at one object a line-color-brightness scheme showing the most interesting part of the visual field will look about like Fig. 7. The greatest brightness and the warmer colors are found around the center, in the background the cooler and darker and the lines either point towards the visual task or are arranged concentrically around it. Now during normal working periods of between 15 minutes to several hours duration our eyes cannot stay fixed on one subject constantly without becoming too much strained.

Involuntarily therefore we look up from time to time, fixing another object at a greater distance than the task in order to relax the muscles adjusting our eye lenses. For that reason we need a second eye task of a similar composition as the first. This second eye task will have two functions: it not only gives the observer an opportunity to rest his eyes, but the second eye task is also to create a center of interest that makes one realize the space in which he works and the distance between the two centers. This generally creates an atmosphere which simply is not there without the second center of interest. We could quote many examples of this phenomena. If one sits reading at the desk under good lighting and one looks up in a room that is rather dark without any accent there is no atmosphere, but if we have on the wall opposite us a picture with warm and bright colors and

Figure 8a. (above) In this experimental room all seeing conditions have been made unfavorable: the wall is white; the lighting very diffused; there is no extra light on the points of concentration; the table and the picture and the colors of the picture and of the table are cool and dark so that the eye is easily distracted by the light and bright background.

Figure 8b. (below) By turning panels it is possible to change entirely the color of the walls, the pictures and the table tops, while direct light may be concentrated onto the tables or the pictures.

that picture is well lit, a second center is created. That second center may as well be created by a decorative table lamp or a bunch of warm colored flowers on a side-board or a table. We have had

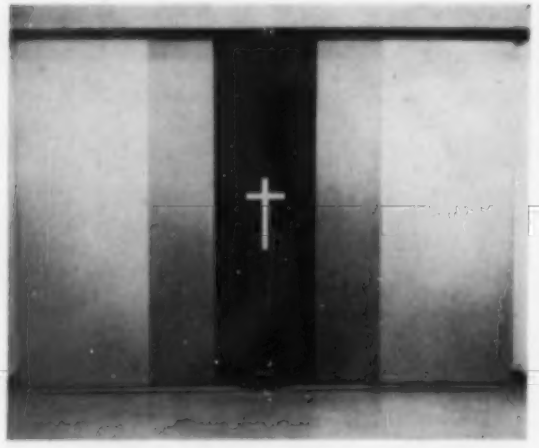


Figure 9. In a niche in the Demonstration Laboratory in Eindhoven, Holland, it is possible by the folding doors to show different light-color-brightness schemes; this figure shows the opposite in brightness distribution, necessary for concentrated attention on the visual task. The center of the church should be the brightest spot.

Figure 10. The brightness distribution in this church as well as the composition of lines concentrate the attention on the center of the church with the altar and the abscissa over it. This is a good example and it is the opposite of the incorrect scheme of Fig. 9.

the opportunity to prove this effect, demonstrating in front of hundreds of observers in the Demonstration Laboratory in Eindhoven in Holland, where a room has been arranged in which the colors of the walls, the tables and the pictures on the walls can be varied together with the light in many ways.

Now there are many other circumstances where the seeing task differs and whereby the position of the observer cannot be fixed as it is in an office or in a school, for instance the places where several people sit around a table or walk about; the direction in which they look cannot be completely defined. For conference rooms, restaurants, shops and stores we have to divide the color-brightness pattern in horizontal zones instead of elliptical solid angles. But there, as in the first example, the scheme will give the decorator as well as the lighting experts precious indications on how to distribute the different brightnesses and colors. In churches we have already indicated that the direction of the eyes should be led by vertical lines to look upward.

It seems adequate to divide the scheme in vertical zones for that purpose to make the central zone the brightest and most colorful and to use in the other zones cooler and darker colors. The shadows on the columns of a cathedral actually do the job in a wonderful way while the usual gold, marble and red on the altar strongly attract the eyes, especially if a concentration of light is arranged on it.

We believe that a small selection of these color-brightness schemes will prove to be very useful to the layman and the expert, the decorator and the lighting man, leaving at the same time ample space for all individual choices and variations in color and lighting effects. They are based upon what we think to be qualities of the human body and spirit which we believe to be of the same nature over the entire world.

There is another group of phenomena in which we find considerable support for our theories. If we look at the beautiful pictures in our museums we find that many of them are built up on similar principles, creating a center of interest by the same means and arranging the surroundings and the background in a very similar way. We want, however, to make it clear, that we do not think that the application of a color scheme in itself necessarily leads to a work of art. We only want to say that the artist intuitively bases his work on the same human qualities we want to satisfy during our daily work.

If one can agree to our suggestion that environment should be studied in the way we have indicated, it will be clear that from our point of view there are many things in the studies and theories

Figure 11. "La Clairière dans le Forêt" by the painter Rousseau, Wallace Collection, London. In this black and white reproduction one can only appreciate the composition of lines and brightnesses which both concentrate the onlooker's attention to the center of the picture. The strongest contrast of the black cows in the bright water with the brightnesses with the rest of the picture diminish towards the frame and the concentric lines of the trees and branches around this center all focus the attention on the most essential part of the landscape.

Figure 12. "The Swing," famous painting by Fragonard in the Wallace Collection, London. The lines of the cord and the arm of the indiscreet onlooker all point towards the center of the picture which is without any doubt the young lady dressed in bright pink with some touches of gold and red. The surroundings and the background are in grays, blues and greens in more or less concentric zones getting darker and darker towards the frame. There is no doubt that all has been done by the artist to concentrate the attention on the young lady on the swing.

Figure 13. Self portrait by Vincent van Gogh. It is very striking to see how modern painters have adopted in many instances a similar system of working. Without any doubt the center of the picture is the pale face with the dark eyes. The colors of the red beard, the blue background and the blue-grayish coat emphasize this center and it is very striking to see how the head and the hat have been painted in strokes, all pointing towards the center of the picture, while the background consists entirely of concentric strokes around this center.

Figure 14a. This is the scheme in color and brightness of an old-fashioned school: light-gray walls, a black blackboard, very dark pulpits and in order to bring some gay note in this dull interior bright yellow curtains. It is clear that the essential points of interest for the pupils, the blackboard and the tops of the desks are certainly not the most interesting.

Figure 14b. (below) By making the blackboard a medium bordeaux-red and the end-wall of the classroom a light yellow or pink, this end-wall and the blackboard become much more attractive. In contrast, the side-walls and the ceiling have been given somewhat darker and much cooler colors as grays and greens. The floor is a dark blue-green linoleum and the tops of the desks are a bright warm natural lacquered wood. In this way, together with the lighting scheme, which keeps the outer corners of the classroom relatively dark, the attention of the children can be much more concentrated on the essential parts of the room.

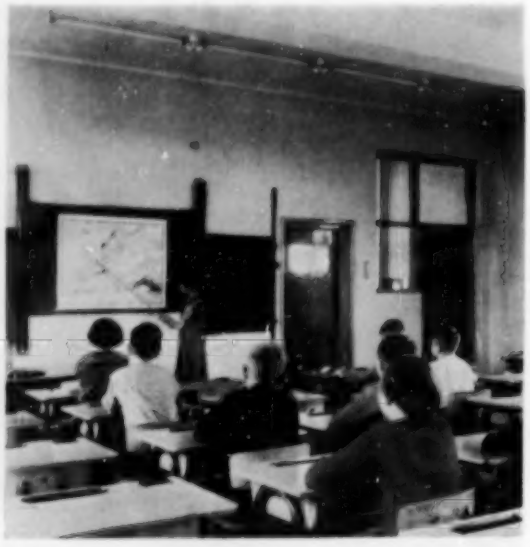


Figure 15. The scheme of Fig. 14b has been realized in this classroom, where the desks are in a light beech-wood, where the end-wall is in pink and the backboard in a purplish red. The side-walls are in a bluish-gray.

about glare contrasts, reflections, colors, brightnesses etc. we cannot agree with. In the first place the technical and scientific attitudes ask for results that can be measured or calculated with the aid of a formula and for that reason they are handled by specialists who have to do their work, making abstractions by which every phenomena or subject can be studied apart from the other. We have tried to prove that it is only the combination of these subjects that counts. Now the man who studies glare or contrasts is probably a student of physics, while the man who studies color may well be a psychologist. This fact alone makes it very improbable that the results can be combined.

We have already mentioned the discomfort-comfort borderline. We once more want to point out here that there is no such a thing and that if we make a distinction between different grades of discomfort it is obvious that there should also be different grades of comfort and that even we can under different circumstances feel certain things to be comfortable or uncomfortable. For instance while for quiet reading we are very sensitive to glare, this same glare — for instance caused by a chandelier in a ball-room — may make a very pleasant effect.

Then there is the general remark that the finding of limits as the glare factor of the admissible brightness contrasts leads only to negative recommendations and for that reason can help to avoid discomfort but can never bring comfort. Recommendations of brightness contrasts have always indicated maximum admissible contrasts. In the first place these maximum contrasts have been studied on surfaces which touch each other without any transition, for instance an opal glass globe on a dark background or a white paper on a dark table. Now these admissible contrasts can be much higher if we make a gradation of brightnesses

Figure 16. In a big store unquestionably the merchandise is the most essential part of the interior on which the attention of the public must be focused. The ceiling has been painted in a night blue and the light is concentrated over the counters and platform on which light and warm-colored goods have been displayed. Show-cases in the wall have an individual illumination and a light warm-colored background. Thus, by the color and brightness patterns the public is attracted by the goods to be sold.

Figure 17. In industry it is possible in many instances to create the ideal picture in the visual field of the workman. Here the center of attraction for the girl is a light warm-colored wooden desk with a brass rotating cylinder. The light is concentrated on that part of the visual field by an individual lamp. The machinery around this little desk has been painted in a pastel blue and the surroundings have a considerably lower illumination value than the place of the actual work.

between the two surfaces. In the second place we should like to have brightness recommendations in the positive sense: what contrasts are comfortable if we want to concentrate on a visual task. We are sure that the absence of contrasts does not lead to comfort: think of reading from white paper while sitting in an integrating sphere of Ulbricht. The next point that has never been studied in connection to comfort are the lighting values we find in our recommendations. Surely we will all agree that mankind in respect to its optical capacities has not changed very much in the last hundred years. Lighting levels, however, have changed considerably, mainly as a result of the changing of the technical and economic possibilities in the lighting field, and the serious studies that have been undertaken in order to give a background to these recommendations have all been based on performance and never on comfort. In the United States the calculations on conditioning of brightnesses generally accept Logan's system where only the visual field is considered, that is seen by both eyes together. We have never received a satisfactory answer to our question why those parts of the visual field that are seen by only one eye are not contemplated. It is impossible for the normal ob-

Figure 18. In canteens as in restaurants it is not possible to speak of one definite visual field, for people, sitting around tables, can be considered only in horizontal zones. Here the zones of the least interest are the ceiling, which receives little illumination and the blue-gray floor. The zones of the highest interest are that of the table surfaces, which are in a light beige color and the zone of the faces of the people sitting around the tables. Here the background is in a light pink, so that two horizontal zones of concentration have been created by a combination of lighting and coloring.

server to make a distinction between the two parts of the visual field.

We hope you will understand that we do not make these remarks for any other reason than that we want to further the problem of human comfort and that we believe that we will always stay far away from reality as long as we do not approach these problems from the human angle. Even to the point of allowing our intuition to dominate our reasoning, because human reasoning is always insufficient as long as our sensations are concerned. We should try to find together new methods of experimenting, trying to stay as near as possible to reality and deriving from these experiments confidence inspiring rules that will perhaps not be very precise but which will lead the architect, the interior decorator and the lighting man to think cooperatively and to work together in order to correct these rules and make them more precise.

We certainly feel the necessity to cooperate with other people interested in these problems in the whole world.

We are convinced that one person in one short lifetime will not be able to find the results we want. We therefore think that an international team should form itself, consisting of people who think along similar lines, come together and try to agree about the methods of research to follow and about the subjects to tackle. If it could work through the whole period between two international congresses of the C.I.E. so that every four years the results of its work could be made known to other lighting experts, we believe that good results may be expected within a relatively short time. Enthusiasm for this kind of work should be inspired by interest in the human welfare, putting aside all selfish striving for personal success.

DISCUSSION

H. L. LOGAN:* The writer agrees with much of what Mr. Kalff has to say with respect to glare and quality of lighting, and sympathizes with Mr. Kalff's efforts to improve the use of color. His color philosophy is fundamentally akin to the writer's or vice versa, but places primary emphasis on value arrangement and pattern. This makes it more applicable to the needs of individuals or small homogeneous groups, than to the mass working groups with which engineers have to deal in industrial and commercial activities.

The writer cannot understand how Mr. Kalff could have gained the impression that the writer excludes "those parts of the visual field we see with only one eye." As far as the writer knows he was the first one to specifically *include them*, both in his spherical perspective protractor and his flux diagram, and to evaluate them numerically as part of the total flux sent to the eye.

The "middle of the road" position that Mr. Kalff adopts on glare and brightness contrasts he appears to abandon on color where he stresses the individualistic treatment of the artist. This works well with individuals, such as an executive who can disregard the wishes of his secretary and have his office treated to satisfy his own color attractions and repulsions. It is not so easily applicable to groups in large working areas where the attractions and repulsions of the individuals forming the group may have no common denominator.

Considering the use of color from the standpoint of the optimum mass working environment, it seems obvious that it should not impose on the involuntary responses of the occupants, but should cooperate with the rest of the synthetic environment to act as a protection, preventing the occurrence of stimuli beyond the optimum range of adaptation of the inhabitants, while at the same time acting as a revealing background to the benefits and hazards enclosed within the space.

This dictates the use of the principle of *indifference* in the choice of colors for group use in working environments. While Mr. Kalff agrees with this, judging by subsequent correspondence with the writer, he did not clearly develop it in his presentation.

Psychological reaction to color is a rather vague and controversial matter. Colors have a lesser influence than some other features of the environment, such as odors or noise. However, it is clear that people have three possible attitudes to color. They like them, or they don't like them, or they are *indifferent* to them.

A statistical study of colors[1] has been made to separate those for which people have a marked attraction and those for which they have a definite distaste. The remaining colors are those to which they have a low or even neutral emotional response. These colors provide backgrounds that are excellent for the necessary luminance manipulation by engineers and do not engage the energies of the workers in the energy-draining channels of emotional responses.

These colors from the "indifferent" group permit engineers to create environments that leave the energies of the workers relatively free from environmental trespass. When the environment attracts attention it acts as a distraction, and to the extent that it does so, it lowers the observer's freedom of choice of the use of his energies. Noise is a conspicuous offender in this respect, of which many people have painful experience.

"Surround" colors for mass working environments, therefore, seem best chosen from the "indifferent" group.

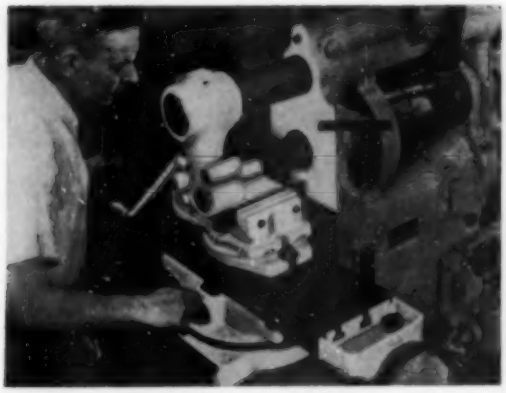
Up to this point the writer believes that Mr. Kalff and he are in substantial agreement. Mr. Kalff has advised the writer he agrees that the environment should be "without distraction" in the sense meant here; and, stating the same thought positively, that colors should be a factor in the process of creating an environment for workers that permits attention to their work with the least effort.

But Mr. Kalff goes farther and believes that a specific pattern, that is color-weighted to focus on a center or centers of attraction, should be developed for each specific interior and seems to argue that this is an artistic function and outside the realm of the engineer.

Here the writer makes a separation in his thinking between the "surround" or "envelope" of the interior and the work, and also between mass working environments,

*Vice President in charge of research, The Holophane Co., New York, N. Y.

[1]Appendix A, The Practical Mechanics of Designing Optimum Lighting Patterns, H. L. Logan, ILLUMINATING ENGINEERING, Vol. XLIII, 1948.



Painting the machine in light colors has increased the visibility of the dull gray work which contrasts with the light background. This makes for efficiency and safety. Working parts in "Spotlight Buff"; body of the machine in "Horizon Gray." Photograph courtesy of E. I. du Pont de Nemours & Company, Wilmington, Del.

and small, homogeneous group environments. The writer finds that the desirable centers of attention in the surrounds of mass working environments are hazards and benefits, such as shaft-way openings in the floor and obstacles (hazards) or drinking fountains, clocks and similar benefits. There is a national safety color code, standardized, for the identification of hazards and benefits which adequately takes care of this.

There are also work centers of attention, the color treatment of which have been well developed by A. A. Brainerd in his "three-dimensional" color work, where the fundamental consideration is sure recognition of the critical work points. The colors used were based on experimental work to determine the combination which would give the surest and speediest recognition of the work points and acceptance by the worker as the most pleasing.

The surround, in mass working environments, apart from specific hazards and benefits cannot, so-to-speak, afford centers of attention. They are in contradiction to Mr. Kalff's communicated statement that the workers' environment should be "without distraction." But the story is different with the actual work. Machines have critical work points that need treatment as centers of attention, and which involve the color treatment of the entire machine (see photo above).

Here Mr. Kalff's suggestions might well be developed in miniature with good results. They might also find some application in small and medium office interiors where the workers' stations are fixed and all oriented the same way.

WARD HARRISON:* When I was asked if I would discuss Mr. Kalff's contribution, I thought that I might want to record disagreement with some of his views. However, it is clear that our differences for the most part had to do merely with the choice of words. Most of us are inclined to consider a lighting installation "comfortable" if the light sources and/or their reflected images do not cause us definite discomfort. Mr. Kalff is an artist and my interpretation of his paper is that he cannot feel comfortable in any room that is not aesthetically pleasing even though the light sources may be entirely above reproach. On the other hand, I surmise that he would not be happy long in a room with glaring light sources even though it were exquisitely decorated. To use a homely illustration, let's consider shoes. Many men are entirely satisfied with a shoe so long as it does not hurt their feet. Not so with the feminine contingent. Their shoes must be attractive in appearance and also in style. Some few accept shoes for these reasons which do hurt their feet. I believe the majority, however, more and more insist that the shoes must not cause discomfort and must be interesting as well. If Mr. Kalff would use the words "attractive," "interesting" or "pleasing" instead of "comfort" perhaps we would come to a better understanding.

I know that Mr. Kalff feels as does Mr. Waldram that the trend of too many of our American designs is that as they become more comfortable (U. S. meaning) they also become as uninteresting as a bland diet. I agree with him. I have also had some experience with bland diets.

G. M. MARKS:* The thing that seems to be causing a great deal of controversy in the world today as well as at Illuminating Engineering Society Conferences, is the interpretation and proper emphasis of what the other fellow is saying.

It should be agreed that our objective as illuminating engineers should be to provide desirable seeing conditions in the office, school, factory and the home. No one can argue about the progress that has been made in this respect over the past 75 years, and especially since the inception of our society.

However, it seems like we are harping on a fine line that leaves room for too much controversy when we discuss whether an environment should be positively pleasurable or an environment should be one that has had discomfort eliminated or at least minimized.

If we provide desirable seeing conditions in the office, school, factory or home by continuing to make progress in eliminating discomfort in any practical manner, a so called *luminous perfume* could exist that would be positively pleasurable.

J. LLOYD KAMM:** The consumer judges his lighting by *how he feels* — by the reaction his person gives to the luminous environment provided. If a large number of people from all walks of life were to make appraisal of a large number of lighting effects, the range of their reactions would include such descriptions as: *dead, dull, depressing, quiet, satisfactory, stimulating, annoying* and *irritating!* These reactions would be a personal matter in which widespread contradictions would prevail. Obviously, an out-of-doors type of person, who found complete self-expression through intense physical activity, would not give a satisfactory rating to the type of lighting effect selected by a mental type of person, and vice versa. These variations in the quality of lighting that is provided by different combinations of lighting equipment and lamps produce what might be called *climatic* values. It is a recognized fact that climates produce marked effects upon man. Once the importance of this factor is appreciated by the lighting industry, the matter of providing a suitable luminous environment will become the prime factor in illumination design procedure.

The need for giving attention to this factor has been indicated by the lack of completeness which most lighting

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*Manager, Lighting Dept., Electric Supply Corp., Chicago, Ill.
**Illumination Consultant, Seattle, Wash.

effects possess. Quite generally, engineers stress the mechanics of illumination design and avoid the artistry of lighting. To an equal degree, the artists do exactly the opposite. As a result, neither of these factions give due consideration to the requirements of the job.

During the fifty years our Society has been active, this phase of illumination design has been carefully avoided. Lighting experts have been at a loss to explain why certain consumers have discarded an apparently fine lighting effect in favor of a system having less merit. In this, they did not understand the consumer's point of view. In fact, a large portion of the underlying cause for growth of "public power" activities has been the inability of power company lighting engineers to provide the consumer with a suitable type of lighting. Certainly, the consumer could not be expected to be happy and enthusiastic when his lighting produced an effect — which *for him* was annoying. Nor would the business flourish if the lighting produced an atmosphere which appeared dead for the buying public.

On awakening to the full importance which this matter held as a public relations problem for the power company, this writer undertook a study of the consumer's requirements for illumination. During the past twenty years, he has called attention to the presence of the condition and has made several contributions towards effecting a correction for it. The industry, however, has made little application of it. In view of this no action attitude, it appears that more benefit would be derived if attention was here devoted to the causes for the avoidance of this subject than would result from a presentation of the research and studies. That, we will do!

Towards the end of the Nineteenth Century, Emerson surmised that man thinking was a composite of the thoughts of all men. Had he lived a century later and was facing the era we are preparing to serve, he would have said that man thinking was a composite of the thoughts of all men *and all women*. In other words, Mr. Emerson lived in the same era in which our electric lighting industry had its beginning. But, that era had given way to another and it thus becomes necessary that old and inadequate concepts be set aside and new ones be adopted in their stead.

Lighting is not the only industry to be affected by this change, although it may be the last to make compliance. For instance, had Mr. Emerson had "running water" installed in his home, the plumber would have probably done a *man's* job of executing the work. He would have placed the iron pipes in the room, used faucets from the boiler room and would have cared little about the appearance of the installation. In contrast, the water pipes are now concealed within the walls, the faucets are of artistic design and the entire system reflects the influence of *woman's* ideals. In an equally impressive manner, the automotive industry has come a long way in revamping its gasoline engine-driven wagon of yesterday into the luxury models of today!

There is far more involved in this change than the fact that the fair sex has ventured out of the kitchen to take an active part in the affairs of the day! Lawrence Heyd, in his book *Isis and Osiris*, defines the Masculine Mind (man) as that which deals with the objective world through the mental faculties — *perception, memory, knowledge, reason* and *judgment;* and the Feminine Mind (woman) as that which deals with the subjective world through the mental faculties — *imagination* and *intuition*.

It is to be noted that a certain pattern of development of these faculties is followed as a race of people reach successively higher planes of civilization. The manner in which a people live depends upon the mental faculty being employed by its leadership. Thus, *perception* affords only tribal life; *memory* and *knowledge* give an era of kings; *reason* and *judgment* sponsor a Mechanical Age; while *imagination* and *intuition* produce the electronic, synthetic and plastic era which we are now entering. Thus, by the use of reason, one can comprehend the flow of water through a pipe line; but it requires the application of the imagination to comprehend the flow of an electric current through a solid copper bar! — (a fourth dimensional feat). Nor did man develop the electrical phenomena before he had evolved the use of the imagination. And, the fact that this additional mental faculty is being employed gives explanation to the change that has been made during the present century. It may well be added that since imagination and intuition are traditionally feminine traits, the attainment of their use by our advanced people is symbolic of and accounts for the presence of *woman* as an active worker in major fields of activity.

It is well known that all peoples do not possess the same degree of command over the use of their mental faculties. Psychologists give but little assistance in determining the capabilities of an individual. Society, particularly in a democracy, does not allocate responsibilities among its peoples with due regard for their capabilities. Thus, the *average mind* — which usually constitutes the group making our decisions — is frequently unable to comprehend the true nature of our problems or to foresee the results of certain actions which they may direct. Consequently, our society cannot rely upon *group action* to provide the industry with an adequate leadership.

On the other hand, if we are to surmount the obstacles which presently confront and limit the lighting industry and the development of the lighting art, it becomes apparent that we must depend upon the guidance of those people who have attained the use of the faculties *imagination* and *intuition* in addition to those more rational faculties *memory, reason* and *judgment*. Being thus equipped, they will be able to comprehend the nature of the subjective self of the individual and thereby understand the reactions which different types of people give to various types of lighting effects. With that information, the industry will be in a position where it can deal effectively with the requirements for luminous environment. And, without that information, the situation will be continually aggravated and our professional standing will be increasingly cheapened.

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A.I.A. File No. 31

INSTALLATION AT McCAUSLAND MOTORS, INC., PHOENIXVILLE, PENNSYLVANIA.

Lighting a Used Car Lot

LIGHTING OBJECTIVE: To floodlight a used car lot to provide illumination for seeing and selling.

GENERAL INFORMATION: This irregularly shaped lot covers an area of 7500 square feet and is located at the intersection of a side street and highway.

LIGHTING INSTALLATION: Twenty Benjamin catalog No. 5934 "Duo Service" floodlights, each using a 1500-watt PS-52 clear general service lamp, are mounted on top of five 35-foot high poles, four units per pole. These poles are spaced 25 feet apart and located around the highway edge of the lot. One Benjamin catalog No. 56816 "Column-Lite," using a 500-watt PS-40 clear general service lamp, is mounted on top of each of two 14-foot high poles spaced 20 feet apart and located at either side of the side-street drive-in entrance. This arrangement, shown in Fig. 2, provides 35 footcandles general illumination.

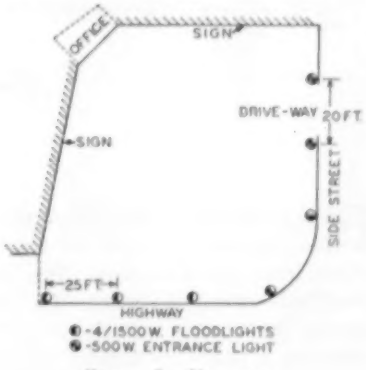

Figure 2. Plan view.

Lighting designed by T. H. Gallagher, Lighting Engineer, Philadelphia Electric Company, 1015 Chestnut Street, Philadelphia, Pennsylvania.

Lighting data submitted by George T. Anderson, Jr., Philadelphia Electric Company, 1015 Chestnut Street, Philadelphia, Pennsylvania as an illustration of good lighting practice and to aid in the design of similar installations.

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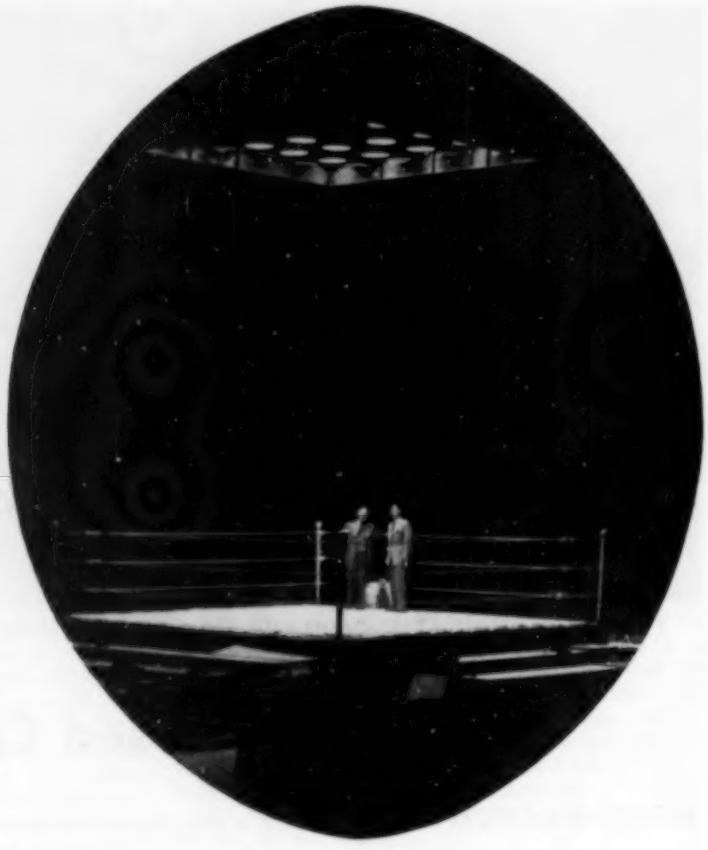


Boxing Ring Illumination

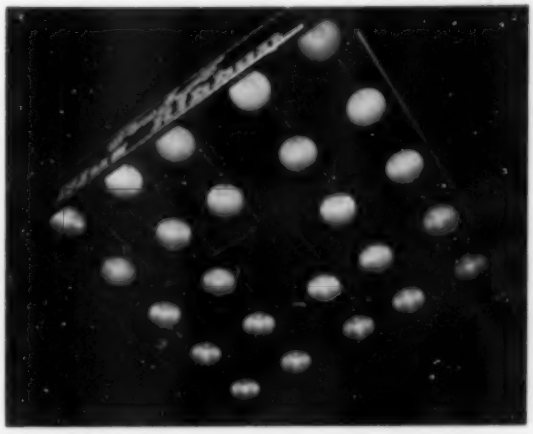
FOR THE assignment of lighting a boxing ring, the lighting engineer has few reflex recollections from previous jobs. The I.E.S. Lighting Handbook covers the matter (p. 12-10) and well-known illumination principles apply, but the application is scarcely routine. Little wonder, perhaps, that the design for the famous San Francisco Cow Palace was the "most interesting job" for C. M. J. Wood and C. J. Selby, of Pacific Gas and Electric Co. Their joint entry was an interesting feature of Northern California Section's contest for My Most Interesting Lighting Job, this spring, and was judged third prize. Lighting layout was by Mr. Wood.

The first thing he ran into was advice from a television expert to "provide 150 footcandles on a vertical plane, and you'll have nothing to worry about." This, of course, meant something like 300 footcandles on the horizontal plane.

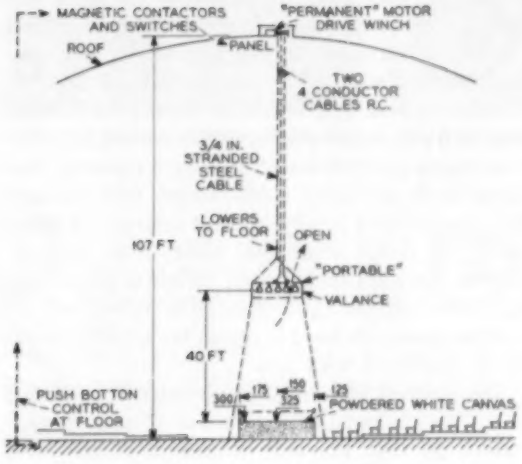
Further, he was told, the whole installation must be portable. The ring itself and all the lighting equipment is dismantled between events, stored and reassembled without the aid of an electrician.

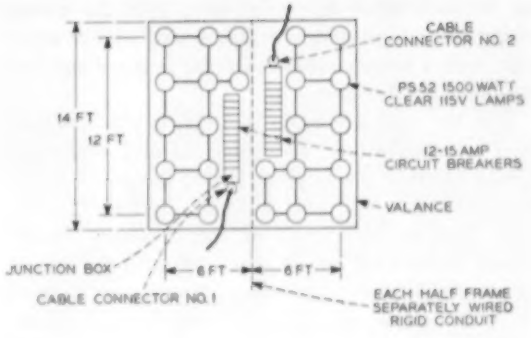
It had to provide the right light in all respects for clear TV pick-up but at the same time not obstruct the view from any seat in the vast balcony. It had to keep heat off the men in the ring. And finally, it must not put glare in the eyes of the fight's highest-priced customers, the ringside spectators.

Calculations started, literally, at the floor. This was a high-reflectance white powdered canvas, which could be counted on to aid in obtaining the desired 300 ft-c. As shown in the accompanying



Close-up of lighting unit at right shows lamps in deep-bowl reflectors. Frame of the unit unbolts into two halves, as shown in the drawing below right. Numbers above boxing ring in elevation, below, give vertical and horizontal illumination in footcandles.





for San Francisco's Cow Palace

sketch, the portable device designed to provide this used twenty-four 1500-watt PS-52 115-volt clear lamps in deep bowl polished ventilated reflectors, closely set within a frame work 12 feet square. The whole assembly is attached to a cable by an electrically-driven winch set at the roof line. For portability, the frame unbolts into two halves of 6 feet by 12 feet each. Reflectors may twist-unlock for storage, and the valance may be unbolted from the frame. The winch winds up the cables. Fabrication and installation was done by the Brayer Electric Company of San Francisco.

Calculations showed, and practical application confirmed, that with a density of 1800 lumens per square foot, an illumination level of 300 ft-c would result on the floor of the ring with the device stationed at an elevation of 40 feet above the ring. At this level, also, no heat is felt by the ring occupants, and no glare experienced by the ring spectators. All action is clearly seen from every seat in the gallery. Actual measurements, with a Weston Paddle-type light meter were: 325 ft-c horizontally at the center of the ring; 300 ft-c at the corners. Footcandle readings on the vertical plane, four feet above the floor were: outer edge, 125 ft-c; center line 150 ft-c; inner edge 175 ft-c. When the white canvas floor padding is in place, the high reflectance from the floor very effectively reduces shadows, a desirable feature for the ever-present television cameras.

The installation has been down, in storage and put up again for one-night shows nearly a dozen times since its first installation. Television men declare it their favorite ring.

Relighting
The Colorado State Capitol Building

By LYLE M. BAILEY — Designer
ELLIS GILCHRIST — Electrical Engineer

WHEN IT was built over sixty years ago, Colorado's State Capitol Building incorporated the finest materials that could be had, and the most beautiful of classic ornamentation. Its huge brass chandeliers and wall brackets were, and still are, classics in the art. The illumination they provided was, however, very very low. Worse still, as demands grew for more light over the years, older lamps were simply replaced with higher wattage, with a proportionate increase in glare and unbalanced brightnesses.

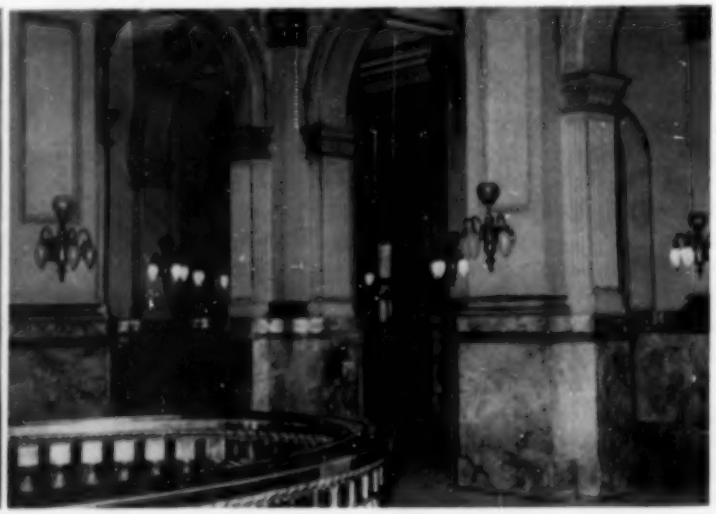
For the complete re-do in 1954, it was specified that all renovations, redecorations and relighting retain entirely the original period design of architectural ornament. This included lighting fixtures. New lighting equipment of contemporary design would be entirely out of character with the atmosphere desired for the building; the existing fixtures were themselves the finest in authentic period design.

Much higher and much more comfortable illumination levels were nevertheless provided in all public corridor and circulation areas. This was done by a combination of unobtrusive additional equipment installed in the central dome of the Legislative Hall, and a modification of existing chandeliers and wall brackets. Sixty-year-old decorative frosted glass shades were removed from the chandeliers and brackets. These were replaced with brass hoods shielding PAR-75-watt and 150-watt flood lamps for a totally indirect system. In many cases, the fixture arms were reversed to correctly position the adjustable hoods. Original gas fittings were retained for their decorative value, and all new parts were finished to match the existing brass-finish discolored with age.

The problem of providing adequate illumination in the Senate and Legislature was of greater magnitude, in that the only source of illumination had been a large ornamental chandelier in the center of each room. A ball lamp border on the high ceiling and around the balcony had been out of use for years, due to excessive glare and diffi-

Architect for renovation, G. Meredith Musick. Color Consultant, Ralph Noble. AUTHORS: Lyle M. Bailey, The Albert Sechrist Mfg. Co.; Ellis Gilchrist, Stiles Electric Service, electrical contractors in cooperation with Brown Electric Co.

FROM 1894 until last year the wall brackets were used in their original form, with frosted glass shades, throughout the corridors and lobby areas.



BEFORE AND AFTER treatments of the ceiling and the central chandelier in the House of Representatives.

culty of maintenance. For sixty years the Solons of Colorado had groped their way about the Legislative Halls in an average illumination of three footcandles.

Here then, in order to provide adequate lighting, it was necessary to introduce the proper additional equipment. The central dome area was covered and the entire room acoustically treated and redecorated. A system of four-square and two-in-line high-bay recessed units with concave lenses was installed. This system, using 300-watt lamps provides 50 footcandles of comfortable glare-free illumination. The central chandelier was raised, modified with indirect and direct lighting hoods to retain the architectural and decorative features. New matching indirect wall brackets were installed above the balcony area to provide an upward component and reduce the contrast of the recessed equipment.

The original antiquity of all the ornamental decoration has been retained; with illumination results that are thoroughly modern and in line with present-day standards of adequate levels and seeing comfort.

IN 1955, pleasing effect is created by indirect lighting from the modified wall brackets — accenting the architectural ornament and color.

Accuracy Of Daylight Predictions By Means Of Models Under An Artificial Sky

By BOB H. REED
MATTHEW A. NOWAK

Comparisons of models or buildings or both on the basis of daylight performance can be made very accurately if ground light and sky light are in similar ratio. Weather and terrain conditions must be equal for the two situations. These can be controlled in model studies, but in full-scale work only the weather can be chosen identically. However, the landscaping can be considered a part of the total design and evaluated along with the building. For average full-scale conditions (a dark green lawn) a reflectivity of 6 per cent is suggested for use in model studies when terrain is unknown.

WITH AN INCREASING interest in the use of daylight in buildings comes a growing desire to have accurate and simple methods for predicting daylight illumination in proposed buildings. This is particularly true in the school building field in which natural daylight has such an important role.

The Texas Engineering Experiment Station started work on daylight prediction methods in 1950 and ultimately developed its first model testing method late in the same year.[1] Previous to the development of the model testing method, attempts were made to compare the effects of different architectural shapes on natural lighting by the use of a full-size experimental classroom. It was realized that to isolate the effects of the architecture, the landscaping and the sky conditions would have to be kept constant. In the experimental classroom's setting, the landscaping stayed fairly constant, except from season to season, but the weather and sky conditions changed continuously. It was the realization that an accurate basis for comparison was almost impossible to hold that brought about the development of the model testing method.

The basis for the original model testing method was the use of an artificial sky under which models could be tested with a fixed landscape condition. This would isolate the effects of architecture and allow for comparisons of different building designs and for predeterminations of the natural lighting of proposed buildings.

In the use of this method, an assumed minimum condition of an overcast sky of 1000-footlambert uniform brightness, which has been generally accepted as a basis for daylight surveys,[2] is used for purposes of comparison and prediction. Models are placed under the artificial sky and a survey is made of the light intensities at various points in the working plane inside the model. These points are represented by E_n in Fig. 1. Simultaneously with each reading taken inside the model, a reference reading is taken on the vertical plane of the fenestration. See E_v in Fig. 1. The reference reading is then adjusted to a value of 500 footcandles (theoretically the intensity produced on a vertical plane under an overcast sky of 1000-footlambert uniform brightness) and the inside readings are adjusted proportionally. More fundamentally, a dimensionless daylight factor can be calculated for each point in the working plane inside the building by the use of the following equation:

$$K_{E_v} = \frac{E_n}{E_v} \qquad \text{Equation (1)}$$

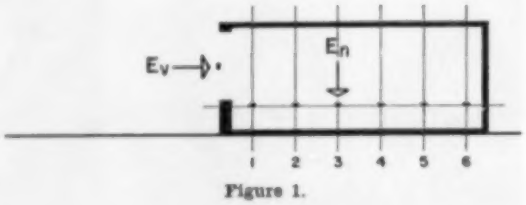


Figure 1.

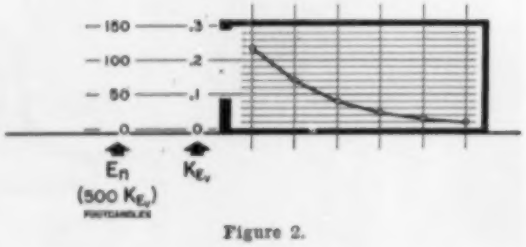


Figure 2.

AUTHORS: Texas Engineering Experiment Station, Texas A. & M. College System, College Station, Texas.

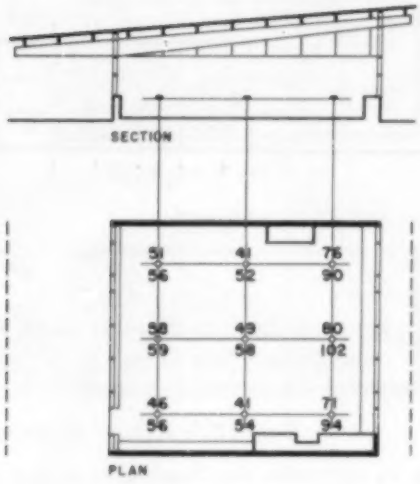


Figure 3. Elementary School, Georgetown, Texas.

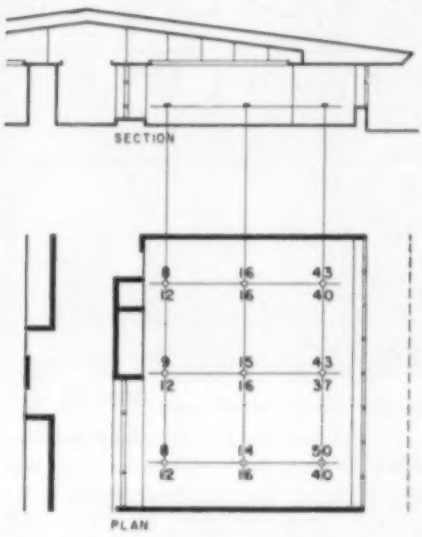


Figure 4. Elementary School, Port Arthur, Texas.

in which K_{E_v} is the daylight factor when using E_v as the reference reading. This results in a curve of K_{E_v} values for a given building as shown in Fig. 2.

Then, of course, footcandle values for the inside readings, E_n, can be calculated for any sky intensity by multiplying K_{E_v} by a value of E_v appropriate to the given sky intensity as when using $E_v = 500$ footcandles as related to the 1000-foot-lambert uniform sky mentioned previously, and as shown in Fig. 2.

By this method, highly reliable comparisons can be made of the effects of architectural shapes in model form, and somewhat less reliable predictions of the natural lighting of proposed buildings can be made depending on the accuracy of the representation of the full-scale conditions of the building and the landscaping.[3]

Since the landscape conditions for a proposed building design are seldom known, it is somewhat difficult to find close agreement between a model prediction for a proposed building and a survey of the building in its final state after construction, as will be shown later in this paper.

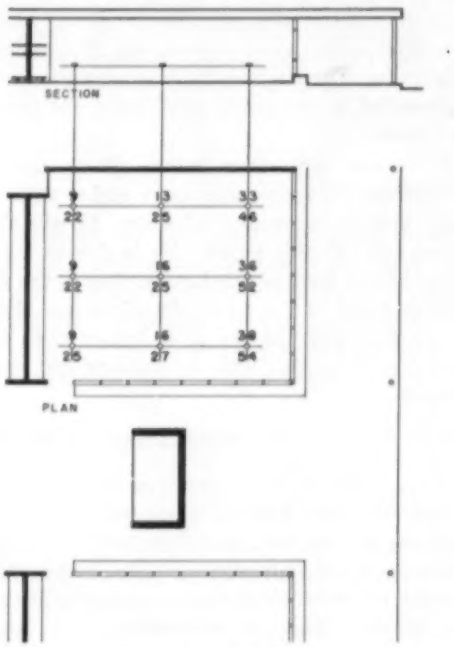


Figure 5. Elementary School, Port Arthur, Texas.

Accuracy of the Original Method

To date, numerous tests have been conducted for architects and school officials throughout the country and abroad, but only recently have some of the actual buildings, tested in model form, been completed so as to provide a further check on the accuracy of the original model testing method. Some of the completed buildings have now been surveyed with the results as shown in the adjoining illustrations (Figs. 3, 4 and 5). In all cases, the upper numerals are for the full-scale building and lower numerals are for the model.

It was the original intention to test the full-scale buildings under an overcast sky, but due to persistent clear weather conditions during the trip to

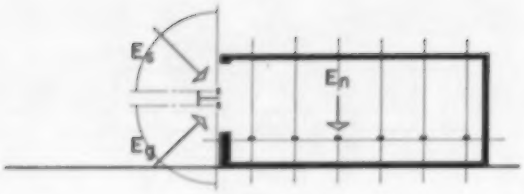


Figure 6.

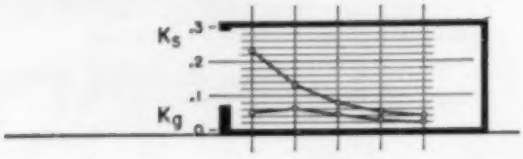


Figure 7.

Port Arthur, the two buildings there were tested under a clear sky.

Analysis of Results

As may be seen by the foregoing results of the full scale surveys, the model predictions were reasonably accurate for the Georgetown school, although they were somewhat high near the large windows. As substantiated by further tests to be described later in this paper, this is undoubtedly due to the fact that the model was tested under a uniformly bright sky, whereas the actual building was tested under a real overcast sky of non-uniform brightness. The landscaping was very close to that represented in the model tests, being for the most part grass.

In the case of the Port Arthur schools, the model predictions were generally much higher than readings taken in the actual buildings. As will also be shown later in this paper, this is due to the lack of similarity between the landscaping in the model tests and that of the actual situations and also due to the fact that the actual buildings were tested under a clear sky with bright sunlight on the ground.

Ground Light vs Sky Light

As a result of the indications of these tests of actual buildings, some of which were tested under landscaping and sky conditions necessarily different from those represented in the model tests, it became apparent that when attempting to isolate the building from the landscaping, as is the case when using total illumination on the vertical window plane, E_v, for the reference reading, the two sources of illumination on the vertical plane, the light from the sky and the light from the ground, have different effects on points in the working plane inside the building. This is substantiated in two recent papers.[4, 5]

In the latter paper was described a survey method which can be used to separate the effects of ground light and sky light. In using this method, the illumination on the vertical plane is separated into ground light and sky light values as shown by E_g and E_s respectively in Fig. 6.

In applying this method it is assumed that:

$$E = K_s E_s + K_g E_g \quad \text{Equation (2)}$$

where E_n represents the illumination at any point in the working plane in the building, K_s is a daylight factor for the sky light, and K_g is a daylight factor for the ground light. E_n, E_g, and E_s are measured simultaneously for each point under consideration in the building. By collecting two sets of readings under various conditions that produce widely different values of E_s/E_g, in other words different proportions of sky light to ground light, simultaneous equations can be set up and the two unknown quantities, K_s and K_g, calculated. Except in the case of a diffusing type of fenestration, K_s and K_g are seldom equal for a given building.[5] For example, K_s is generally much higher than K_g for the ordinary classroom in a school building using clear glass windows. A typical set of K_s and K_g curves is shown in Fig. 7.

Now, since $E_n = K_{E_v} E_v$ (see equation 1) when using total illumination on the vertical plane for reference reading, and since $E_n = K_s E_s + K_g E_g$ (equation 2) when separating sky light and ground light, then:

$$K_{E_v} E_v = K_s E_s + K_g E_g \quad \text{Equation (3)}$$

And since, by definition,[5] $E_v = E_s + E_g$ then:

$$K_{E_v} = \frac{K_s E_s + K_g E_g}{E_s + E_g} \quad \text{Equation (4)}$$

Obviously, for any value of E_s/E_g, (that is for any proportion of sky light to ground light), K_{E_v} must lie somewhere between K_s and K_g. If E_s and E_g were equal, K_{E_v} would be half way between K_s and K_g at all points since the equation (4) would reduce to $K_{E_v} = \frac{K_s + K_g}{2}$. Furthermore, as E_g decreases, or as E_s increases, in other words as E_s/E_g increases, *i.e.*, as produced by a thin bright overcast

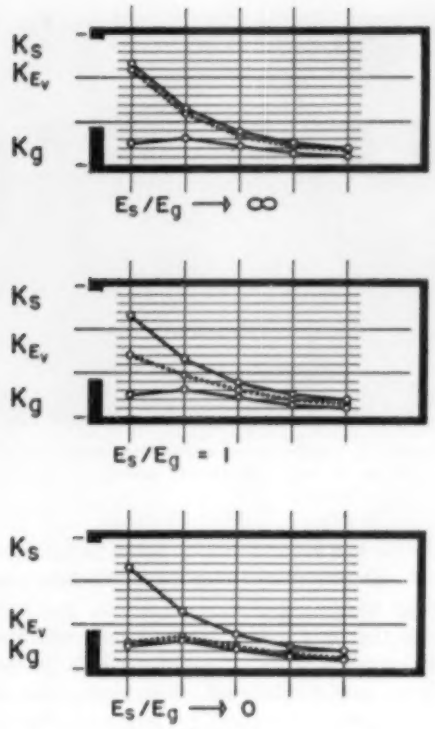


Figure 8.

sky and dark ground, K_{E_v} will approach K_s. And as E_s/E_g decreases, *i.e.*, as produced by a clear blue sky with sunlight on a bright ground, such as concrete, K_{E_v} will approach K_g. See Fig. 8.

It follows then, that when attempting to isolate and compare architectural shapes, whether they be models, actual buildings, or both, and when using the method calling for the value of the total light on the vertical plane, E_v, for the reference reading, the value of E_s/E_g should be the same for the different situations being compared.

Otherwise, in order to isolate and compare architectural shapes, the separation of sky light and ground light method should be used, values for K_s and K_g calculated, and equal values of E_s and equal values of E_g assumed for all situations being compared. In other words, when considering both the sky and the landscaping as sources of illumination, they both have to be standardized separately.

The preceding analysis explains the lack of agreement between model and actual building in the case of the Port Arthur schools considered earlier in this paper. The model was tested under a uniformly bright artificial sky and with an assumed dark green terrain represented. This situation, of course, results in a rather high value for E_s/E_g, the dark green ground contributing very

Figure 9. Two cells on exterior vertical surface.

little light to the vertical surface reference reading, E_v. The actual building was tested by necessity on a clear day with bright sunlight on the terrain. In addition to this, the building was surrounded by either bare, light colored, sandy soil or bright concrete walks and play terraces. Although E_s and E_g were not measured separately at the time of the tests ,the value of E_s/E_g was undoubtedly very low (possibly less than unity) because of these circumstances.

Recent Studies

In order to test the validity of the foredrawn conclusions further and to investigate new and more reliable methods of testing and comparing building and landscape designs, additional and more extensive model and full-scale tests have recently been conducted by the Texas Engineering Experiment Station.

The room selected for testing is located on the first floor of the Engineering Building, A. & M. College of Texas. It is 24 feet deep by 27 feet wide, and has clear glass windows facing northwest. Reflectances of all surfaces within the room as well as of the terrain facing the room were taken for later reconstruction with the model.

Three Weston-Illumination Meters Model 756, incorporating viscor filter and cosine correction were used in measurement of the illumination of the room. Two of the cells were placed on the exterior vertical surface of the room to measure the ground light, E_g, and sky light, E_s. Fig. 9 shows the mounting of the cells and the baffle used in the separation of ground light and sky light.

The third cell, used inside the test room to measure illumination for each point in the working plane, was mounted on a stand of a height repre-

Figure 10. Cell on 30-inch high stand.

Figure 11. Lights placed under translucent terrain.

Figure 12. Color- and cosine-corrected cell adapted to model study.

senting a conventional 30-inch work surface as shown in Fig. 10. The stand was moved from point to point and leveled before each reading was taken. At each point, an interior illumination reading was taken simultaneously with the exterior illumination readings. All meters were checked in a photometer and calibration charts were made for each meter.

Observations of the illumination within the test room were made when the days were either completely overcast, partly cloudy with no sun on the ground, partly cloudy with sun on the ground, or clear sky. On days when the sun was on the ground, the sun did not fall on the fenestration nor did it fall upon the light cells. Investigations within the test room were conducted at such a time that the building cast a minimum of shadow in front of the exterior reference cells. A run within the test room would be taken in five minutes or less. Several runs were recorded and average readings were computed.

With the data collected on the illumination of the test room, a model of the room, scale ¾ inch to one foot, was constructed. Every essential detail was accurately reproduced.[3] The terrain facing the test room was also reproduced to scale and given its proper reflection value. The model with its terrain was then placed under the artificial sky where all four sky conditions under which the full-scale room had been investigated were reproduced. In each case, careful attention was given to reproducing as closely as possible the proper E_s/E_g ratio as found under actual sky conditions. Fig. 11 shows lights placed under a translucent terrain to raise the illumination of the terrain in order to lower the E_s/E_g ratio as found under clear sky conditions.

Two cells were used to measure illumination in the model study. A Weston photronic cell, Model 856RR-V was used to measure illumination within the model room. The cell was color and cosine corrected and adapted to model study as shown in Fig. 12.

A 25-mm diameter cosine corrected photocell was used to record exterior illumination. This cell was mounted in a light separator as shown in the following photographs in order to determine the amount of light falling on the fenestration from the sky and from the ground. With the light separator placed as shown in Fig. 13, only light coming from the sky is measured. In Fig. 14, the light separator is placed so as to exclude sky light and to allow the cell to measure ground light. A similar light separating device has been used previously by others.[6] The cells were attached to a

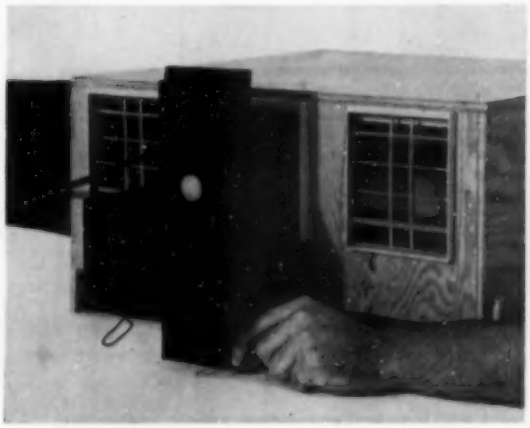


Figure 13. Set-up for measurement of sky light.

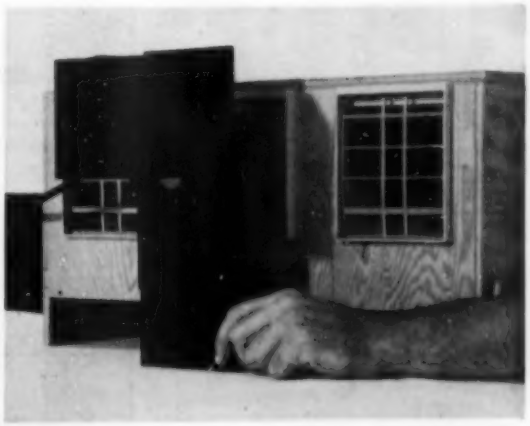


Figure 14. Set-up for measurement of ground light.

Leeds and Northrup Type P galvanometer through a switching device whereby exterior, E_s, E_g, illumination or interior, E_a, illumination could be measured. Calibration of both cells was checked periodically throughout the entire testing program.

Comparison Methods

Two methods were used to compare the model with the full scale test room. One, the original model testing method by which the total illumination falling on the vertical surface, E_v, is used as the reference value, and, thereby, calculating K_{E_v} as the daylight factor. This is given by equation 1.

$$K_{E_v} = \frac{E_a}{E_v}$$

Two, another method by which only the illumination coming from the sky, E_s, is used as the reference value and calculating K_{E_s} as the daylight factor. This is given by the equation:

$$K_{E_s} = \frac{E_a}{E_s} \qquad \text{Equation (5)}$$

Consideration of Accuracy Between Full-Scale Test Room and Model

In Graphs 1 through 4, K_{E_v} has been plotted for the full-scale test room and the model and placed on the same graph to show per cent deviation of illumination found in the model under the artificial sky from that found in the full-scale test room under actual sky. In each of these four graphs, the E_s/E_g ratio is nearly the same for the full-scale test room and the model. The average deviation of the model from that of the full scale test room was 6.2 per cent. The largest deviation was 16.5 per cent which was experienced on a clear day of E_s/E_g ratio 1.05.

In Graphs 5 through 8, K_{E_s} has been plotted for the full-scale test room and the model. Maintaining the proper E_s/E_g ratio, the average deviation of the model from that of the full-scale test room was 6.9 per cent, and the maximum deviation was 14.5 per cent.

In either method, whether using K_{E_v} or K_{E_s} as the daylight factor, comparison within 20 per cent can be achieved, provided nearly equal E_s/E_g ratios are maintained.

Consideration of Effects of Changes in E_s/E_g Ratio

In order to study the effects of changes in the E_s/E_g ratio pertaining to the two definitions of the daylight factors employed in the testing methods, Graphs 9 through 12 are presented showing the plotted daylight factors K_{E_v} and K_{E_s} for each of the five points selected in the working plane of the model and full-scale test room. In Graphs 9 and 10, K_{E_v} and K_{E_s} are plotted for the model. In Graphs 11 and 12, K_{E_v} and K_{E_s} are plotted for the full-scale room. Each of the curves is identified by its E_s/E_g ratio.

Graphs 9 and 11 show that a decrease in the E_s/E_g ratio, which may be caused by a decrease in sky light, increase in ground light, or both, is denoted by a decrease in the K_{E_v} values. When the daylight factor is defined by K_{E_v}, the terrain is considered as a secondary source of illumination as recorded by the E_v reference reading. Since ground light is less efficient than sky light in raising the illumination at points in the working plane inside

1

E_s/E_g = 1.05 E_s/E_g = 1.02

TOTALLY CLEAR SKY
DIRECT SUN ON GROUND

2

E_s/E_g = 1.59 E_s/E_g = 1.58

PARTLY CLOUDY SKY
DIRECT SUN ON GROUND

3

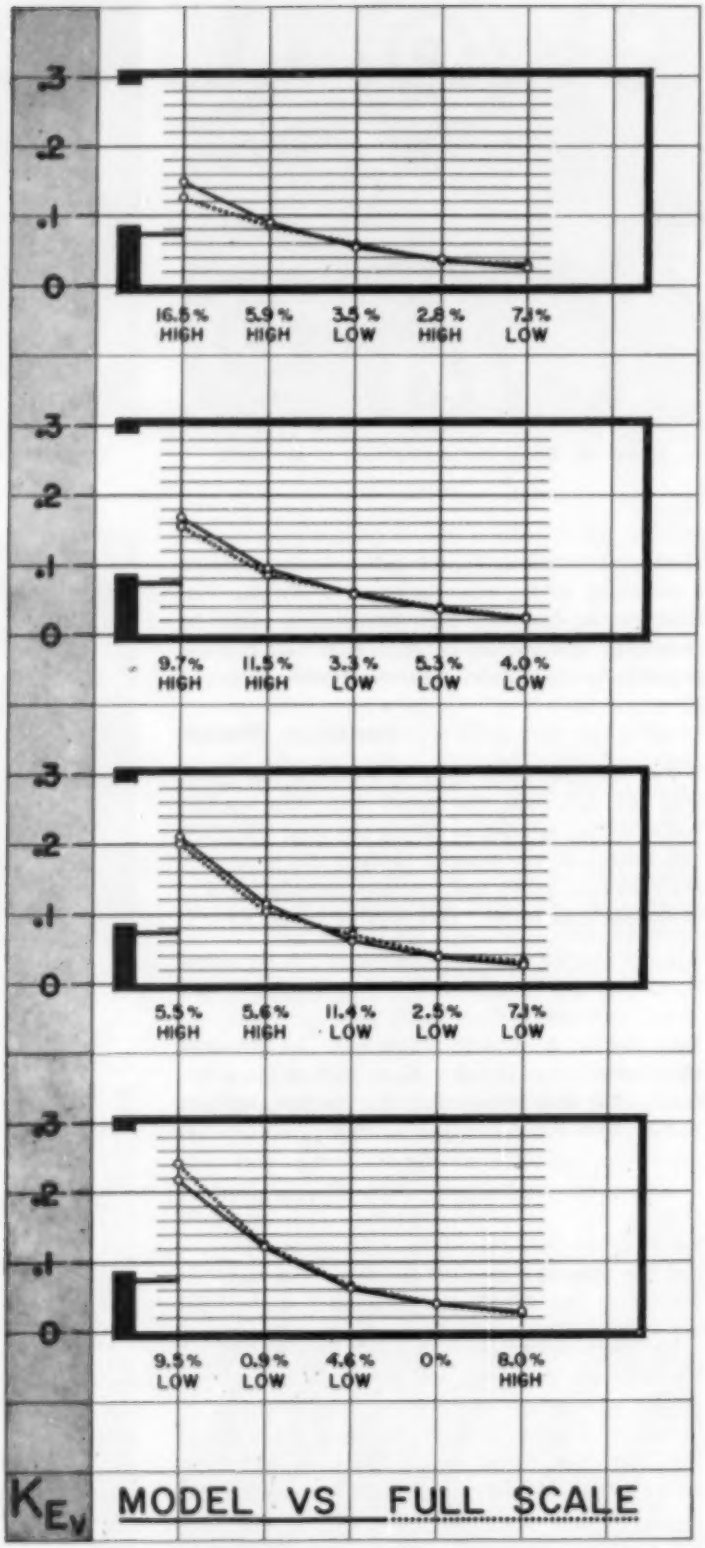
E_s/E_g = 7.60 E_s/E_g = 7.79

PARTLY CLOUDY SKY
NO DIRECT SUN ON GROUND

4

E_s/E_g = 7.40 E_s/E_g = 8.00

TOTALLY OVERCAST SKY
NO DIRECT SUN ON GROUND



Graphs 1, 2, 3 and 4.

5

E_s/E_g = 1.05 E_s/E_g = 1.02

TOTALLY CLEAR SKY
DIRECT SUN ON GROUND

6

E_s/E_g = 1.59 E_s/E_g = 1.58

PARTLY CLOUDY SKY
DIRECT SUN ON GROUND

7

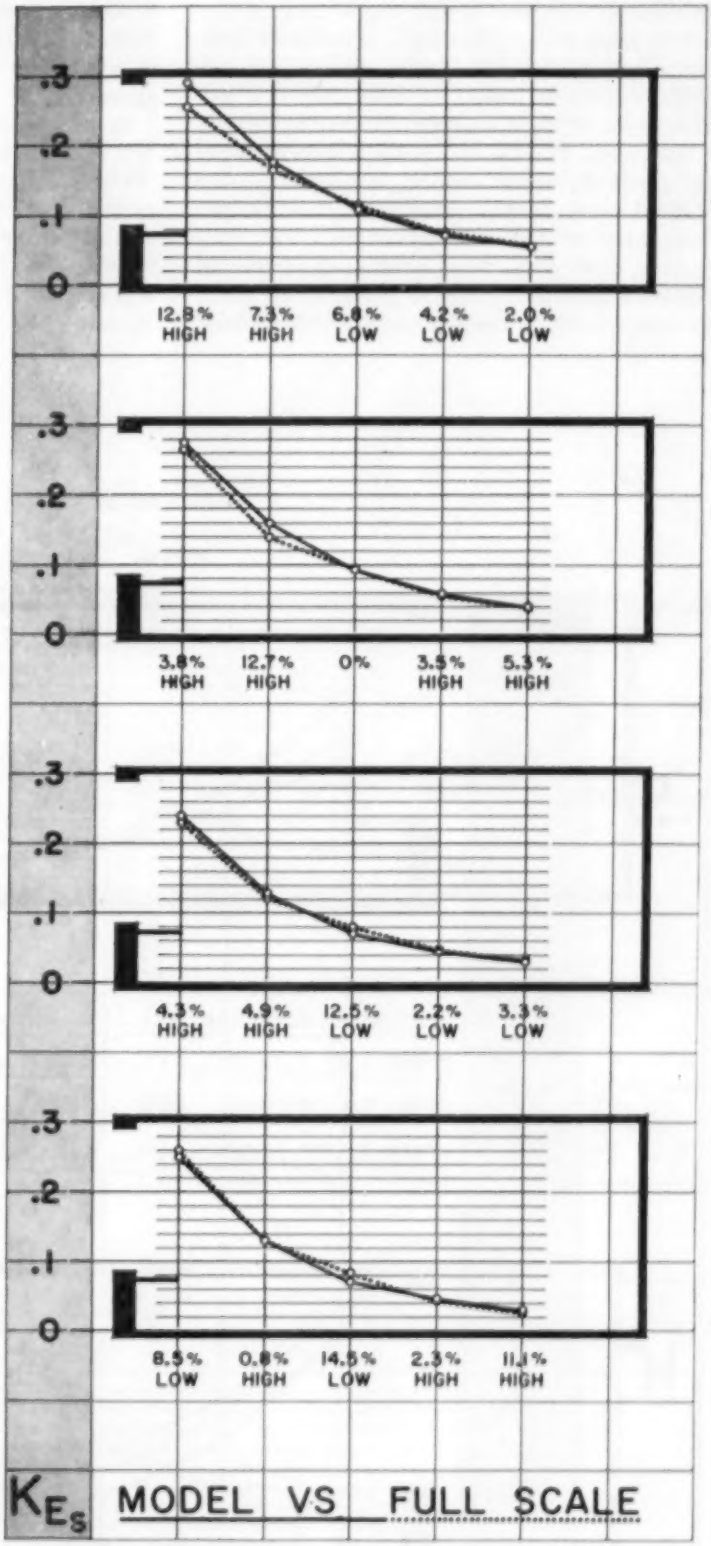
E_s/E_g = 7.60 E_s/E_g = 7.79

PARTLY CLOUDY SKY
NO DIRECT SUN ON GROUND

8

E_s/E_g = 7.40 E_s/E_g = 8.00

TOTALLY OVERCAST SKY
NO DIRECT SUN ON GROUND

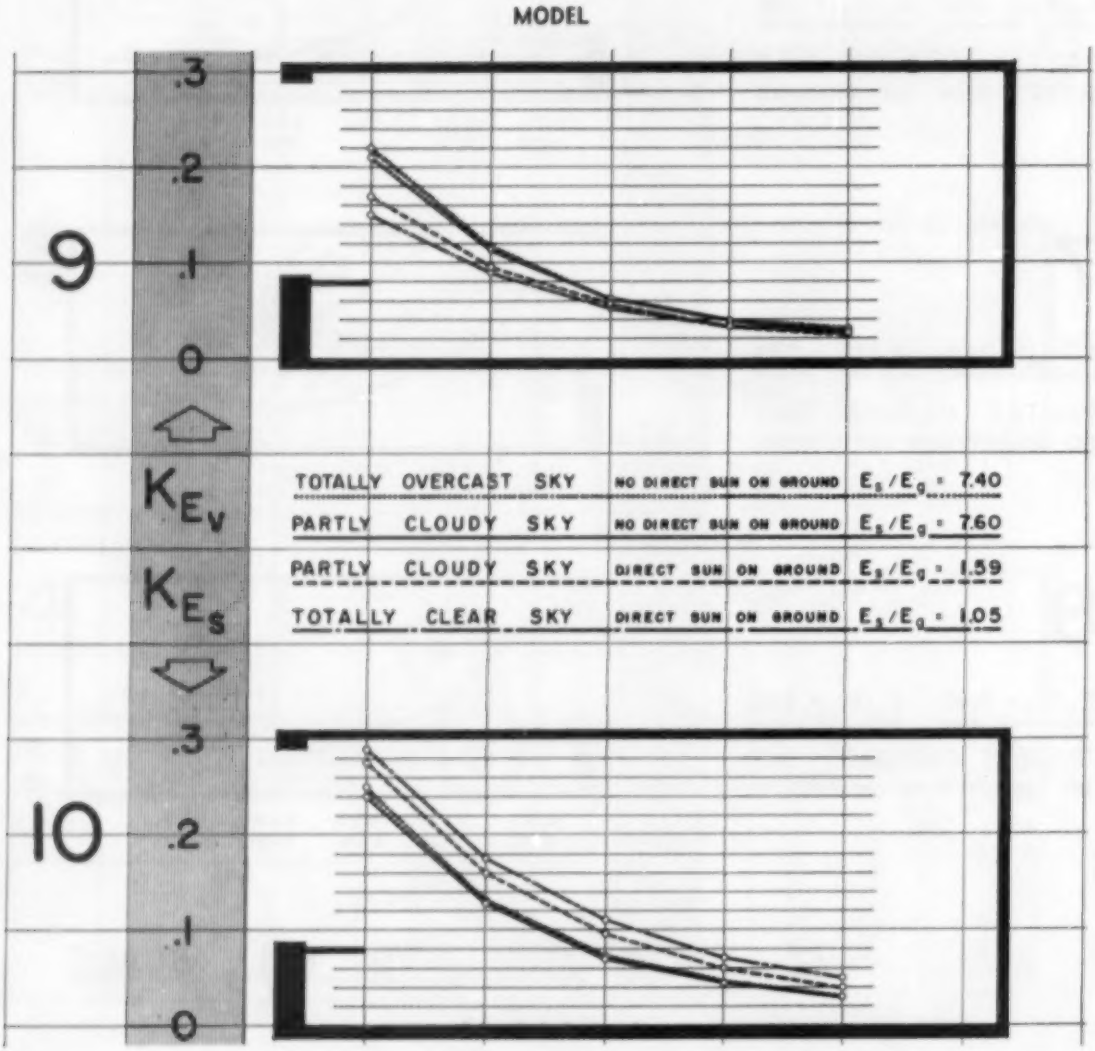


Graphs 5, 6, 7 and 8.

the room as compared to the illumination on the vertical plane of the fenestration, it therefore holds that an increase in ground light causes a decrease in K_{E_v} values. It should be noted that this was brought out in the discussion following equation 4 of this paper. This likewise causes a corresponding decrease in E_a values when E_a is proportionately adjusted to standardize values of E_c, such as 500 footcandles as described previously. With this situation existing, increased terrain reflectivity will indicate a general decrease of illumination within the room when E_c is used for the reference reading. Erroneous results are thereby produced when this method is used for evaluation of illumination within a building when changes in landscaping are experienced.

In Graphs 10 and 12, the K_{E_s} values increase with a decrease of E_s/E_g ratio. When E_s is used for the reference reading, landscaping is considered as part of the total design of the building and not as a secondary source of illumination. Therefore, increasing the illumination coming from the terrain will increase the K_{E_s} values as well as the adjusted E_a values. By this method, true evaluation of day-

Graphs 9 and 10.



light illumination within buildings with their landscaping, whether they be model, full-scale, or both, can be achieved.

Conclusions

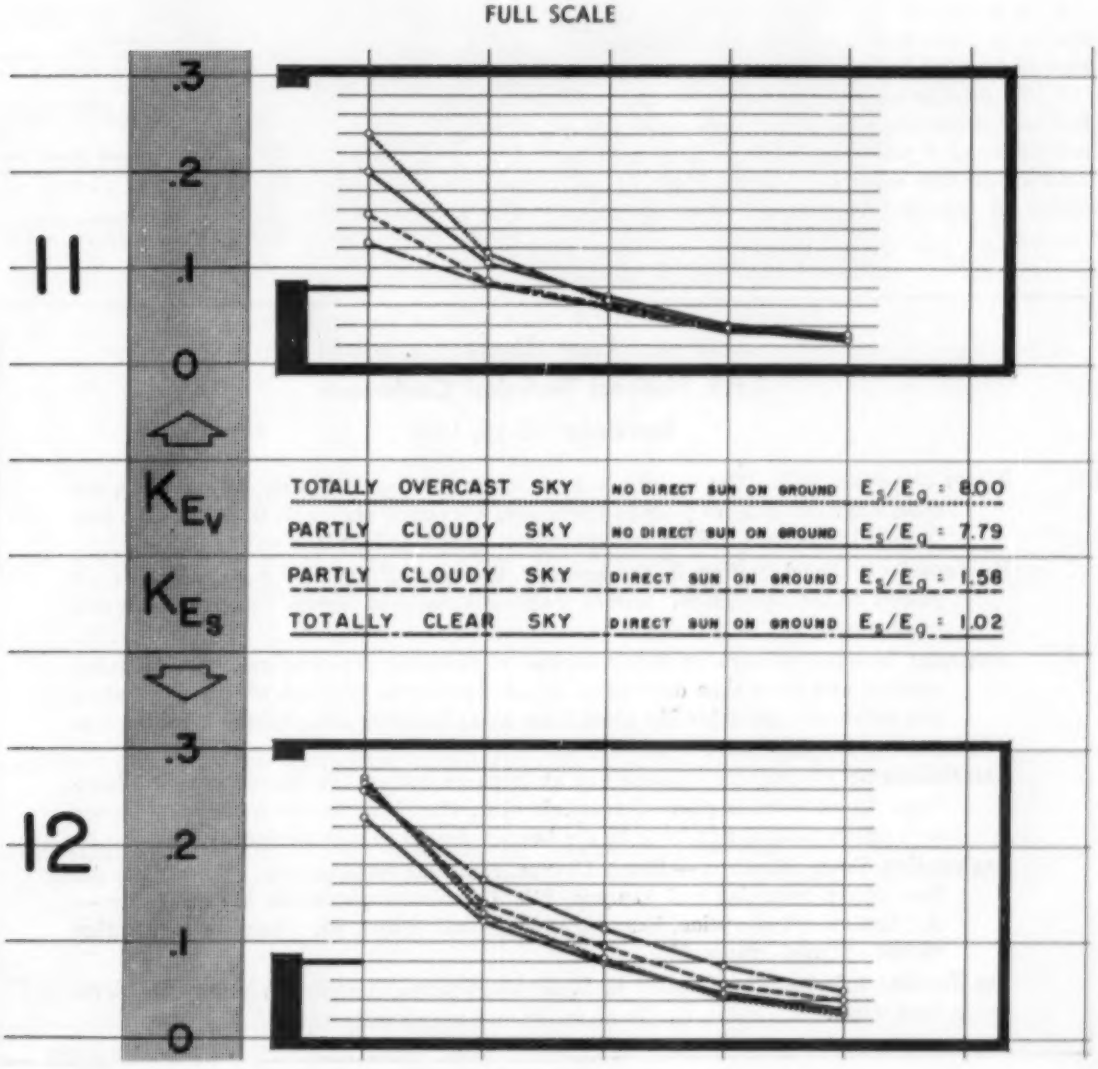
1. Accurate daylight predictions of proposed buildings by the use of models or accurate comparison of buildings (models, full-scale buildings, or both) may be had only when E_s/E_g ratios are nearly equal, whether using K_{E_v} or K_{E_s}. This is true when attempting to isolate architecture from landscaping.

2. Differences in weather and terrain both produce differences in E_s/E_g ratios. Therefore, weather and terrain must both be nearly equal in different situations in order to have accurate predictions and comparisons of buildings independent of weather and landscaping.

3. Weather and terrain conditions can both be controlled and kept constant in model studies, therefore; accurate comparisons can be made of buildings only (isolated from landscaping).

4. In full-scale situations, weather conditions can be chosen nearly identical enough for compari-

Graphs 11 and 12.



son purposes but terrain conditions cannot be so chosen. Since this is true and consequently landscaping cannot be eliminated as a variable, it should be considered a part of the total design and evaluated along with the building.

5. Both K_{E_v} and K_{E_s} vary with variations in E_s/E_g. K_{E_v} varies less than K_{E_g} but gives an erroneous evaluation of the landscaping, indicating a decrease in illumination in the building with an increase in terrain reflectivity. K_{E_g}, however, indicates an increase in illumination in the building with an increase in terrain reflectivity.

6. In attempting to compare daylight performance of an actual building pre-tested by the use of models, the survey method, the type of sky and terrain, and the E_s/E_g ratio must nearly be the same to attain agreeable results, otherwise, a large per cent of error may be experienced.[7]

7. It is felt that K_{E_g} should be used for daylight studies in order that landscaping be considered a part of the total design and be evaluated properly.

8. To provide average conditions as found in full-scale situations, a terrain of dark green grass, reflectivity of 6 per cent should be chosen to be used with models when predicting daylight illumination in proposed buildings with an unknown terrain.

9. For most consistent results, all surveys should be conducted under overcast sky conditions.[3]

10. Conditions other than overcast sky may be used successfully provided conditions are nearly identical in situations being compared. Other weather conditions which can be found somewhat repeatedly in nature but which have greater limitations for testing than the overcast sky are as follows: (a) clear sky (with no direct sun rays entering building or falling directly on light cells); (b) partly cloudy sky with no direct sun on terrain; and (c) partly cloudy sky with direct sun on terrain (no direct sun rays entering building or falling directly on light cells).

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Fact Sheet

I.E.S. National Technical Conference

September 12-16, 1955

Place: Cleveland, Ohio. The seventh largest city in the United States. September is the most beautiful time of year in Cleveland. Cleveland claims its streets are the best lighted in the world. Easy transportation by car, train, plane or bus.

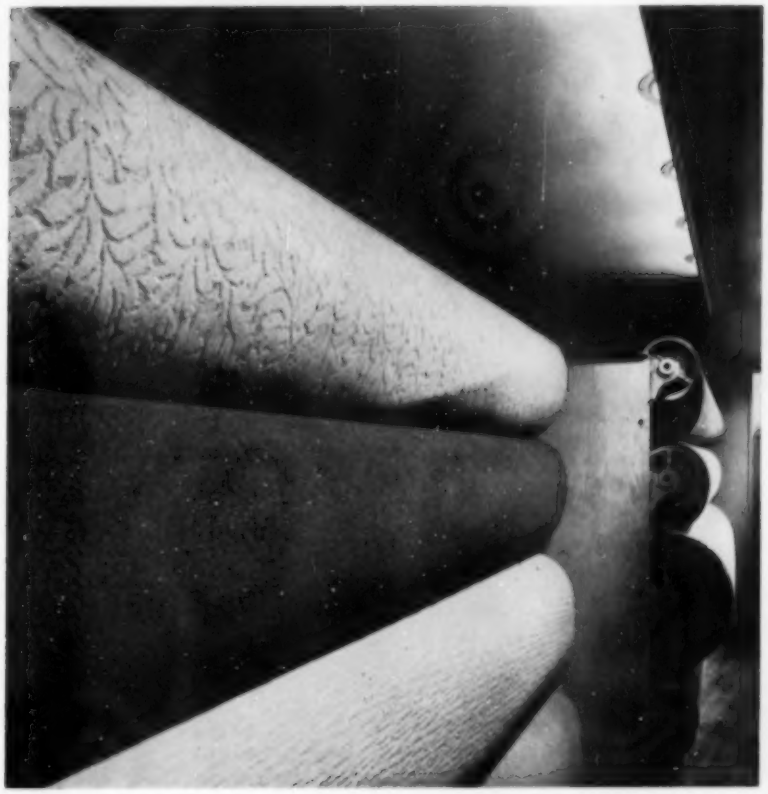
Headquarters: Hotel Statler, in the heart of the city. Fully equipped to handle all phases of the conference. Within walking distance of movies, theaters, stores and restaurants.

Program: Monday through Thursday devoted to technical presentations. More parallel sessions and more time devoted to actual lighting installation practice, including the national contest for My Most Interesting Lighting Job. Friday is reserved as "committee day."

Entertainment: Cleveland's cosmopolitan atmosphere will set the theme for your leisure time. In addition to planned entertainment, Cleveland is noted for its theaters and restaurants, specializing in the best of American and foreign dishes.

Registration Fees: Members — Guest Charge, technical sessions only, $2 per day. All fees except reception and banquet, $10. Complete registration, $19.50. Ladies — All fees except reception, banquet and optional events, $5. Complete registration except optional events, $15.

For Further Information: Contact C. L. Amick, General Electric Co., Nela Park, Cleveland, Ohio.



INSTALLATION AT NORTH PARK FURNITURE COMPANY
1386 HERTEL AVENUE, BUFFALO, NEW YORK.

Lighting a Rug Rack

LIGHTING OBJECTIVE: To provide localized lighting for rug racks in a furniture store.

GENERAL INFORMATION: Each of the six rug racks contains four rolls of carpeting. The center of the top roll is approximately 6 feet 6 inches above the floor and each rack is approximately 12 feet 3 inches long.

INSTALLATION: Each rack is illuminated by six recessed Pittsburgh No. 56 asymmetric reflectors on 2-foot centers, 3 feet out from the axis of the rug roll and 8 feet above the floor. Each unit uses a 200-watt inside-frosted general service lamp. Fig. 2 shows a plan view of the specialized lighting layout and Fig. 3 shows a section through the canopy and rug display.

(over)

A.I.A. File No. 31

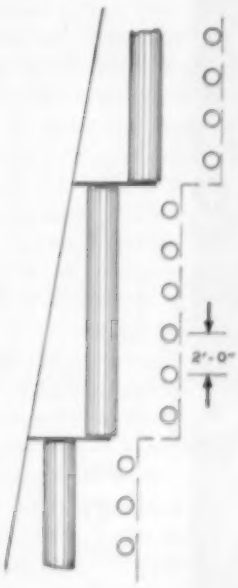
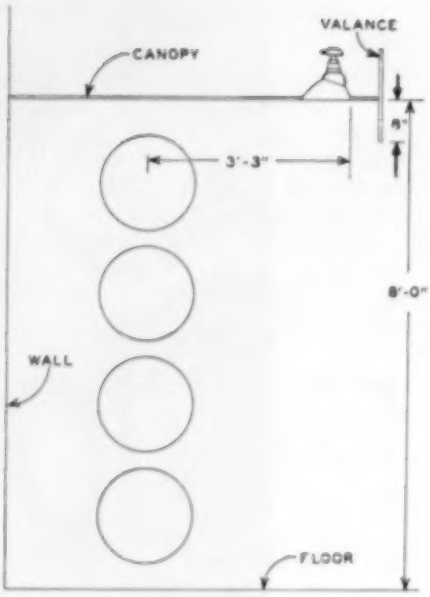


Figure 2. (left) Plan view.

Figure 3. (right) Section through rug display and lighting unit.



Illumination values are as follows:

Front face top rug	60 ft-c
Front face upper center rug	50 ft-c
Front face lower center rug	23 ft-c
Front face bottom rug	13 ft-c

Lighting designed by Norman Harrington, Niagara Mohawk Power Co., Genesee St., Buffalo, N. Y., and installed by Dobkin Electric Construction Company, 57 East Market Street, Buffalo, N. Y.

Lighting data submitted by Leo P. Gauthier, Western New York Data Sheet Chairman, 407 Jackson Building, Buffalo, N. Y. as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

These outdoor lighting installations were all entries in this year's contests, in Canadian Sections and Chapters of IES, for My Most Interesting Lighting Job.

Outdoor Lighting In Canada

Palais de Glace—Quebec

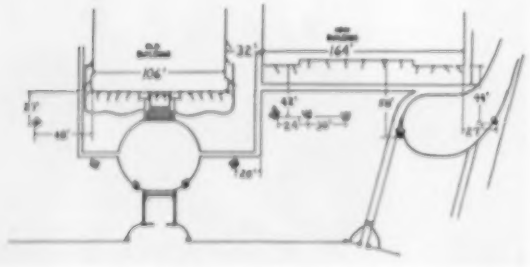
A tingling sensation of thrill at unusual sights and colors is all part of the fun at a Carnival. This thrill is enhanced still further at the annual Winter Carnival in Quebec City, by the exhilirating nip of Father Frost. All factors had a large assist from George Watters, Quebec Power Company, at this year's Carnival, who introduced the effects which can be obtained from lighting. He floodlighted the Ice Palace, inside and out, adding color and sparkle to the ice-block structure.

Inside the palace, two 150-watt sodium vapor floodlights, installed at the top level, created a warm yellow glow throughout the icy building, and through the doors and windows. Outside, six 400-watt mercury vapor floodlights, *not* color corrected, were placed a few feet away all around the palace. From these sources the ice was floodlighted with an eerie bluish-white light, in beautiful contrast. Strings of colored lights encircle the giant candle which rises 60 feet in the air.

The installation won first prize in Quebec Chapter's contest for My Most Interesting Lighting Job, and tied for third place in the Region.

A Building of Both Classic and Modern Design—Waterloo, Ontario

In floodlighting a building it is necessary that its form and beauty be neither distorted nor obscured and that the structure retain its identity. Buildings impress one not so much by their size or mass as by their beauty of outline and harmony of proportions. The most appropriate type of floodlighting for a building depends upon its architecture and the effects to be achieved. In the case of the Mutual Life Assurance Company building in Waterloo, Ontario, there were in fact two buildings or wings. One wing was approximately 50 years old and featured ornamental stone work, balustrades and columns at the entrance. The new wing, built last year, was on the other hand quite modern with plain lines and large windows. The type of brick used was the same in both wings, but the older structure appeared darker due to weathering. The task here was to design a system with a uniform appearance throughout, although in reality the wings were not uniform. Solution to this problem won for its engineer, L. R. Nordby, Canadian General Electric Company, third place in the Toronto Section contest for My Most Interesting Lighting Job.



Reflectances for the light buff brick were roughly 45 per cent for the older wing and 60 per cent for the newer wing. With this as a start, an illumination goal was set for 15 and 12 footcandles respectively for the two areas. To determine the approximate number of lumens required for the front of the older wing, an arbitrary utilization factor of .6 was used. This section of the building is 60 feet high by 106 feet long, therefore, $\frac{60 \times 106 \times 15}{.6}$ or 159,000 lumens was required. Similar calculations for the new wing which is 40 feet by 164 feet showed a need for 131,200 lumens. For this, 1000-watt floodlights were indicated. Restrictions on the location of the floodlights limited the beamspread to a certain extent since they could not be mounted farther than 100 feet nor closer than 60 feet from the older wing. A beam spread sufficiently wide, however, was required so that the overlap of beams would accent the masonry details of the older structure by soft shadows, and at the same time reduce any reflected glare from the large window area of the new building. A unit was used having a beamspread of 55° x 55° with 11,000 beam lumens and

an average maximum beam candlepower of 44,000. With the units placed at an average of 65 feet from the old building and 42 feet from the new building, the beam utilization factor was computed as .8. From test results the maintenance factor of these floodlights was found to be .75.

The following equation was then used to determine the number of units required.

$$\text{No. of Units} = \frac{\text{Area} \times \text{Footcandles}}{\text{B.U.F.} \times \text{M.F.} \times \text{Lumens/unit}}$$

Substituting the proper values in the equation it was calculated that 15 units were required for the front of the older wing and 12 units were required for the newer wing. By the same method it was determined that three floodlights were required on each side of the older wing to light an area approximately 20 feet deep adjacent to the corners.

Location of the floodlights was the last item to be considered in the design of the system. As shown on the plan view, floodlights are located in groups of three or four. This method of locating the floodlights is mainly one of economics as it will keep wiring and installation costs to a minimum. Further, it provides an easy way of making the floodlights inconspicuous in shrubs planted to hide them. In this particular case, the floodlights were mounted on six-inch concrete pads directly on the ground. Power was supplied by two underground feeder lines from a transformer room just inside the building. Although the units can be seen in the photograph, shrubs will shortly be planted to conceal them. With this item accomplished, all five of the original objectives will have been achieved: proper perspective, natural shadows, adequate illumination, building integrated with its surroundings, and units inconspicuous.

Church Facade — Sherbrooke, Quebec

The cut-off shadow shown in the picture is on purpose, in this church floodlighting installation. The system was planned to use the steps and balustrades as a shield from the floodlighting, for the congregation coming out of the church at night. This it effectively does, without detracting unduly from the beauty of the lighted church. The building is of gray stone 65 feet wide and 110 feet high. Frontage floodlighting was required on as simple and inexpensive a basis as possible. Using only two 400-watt mercury vapor floodlights placed at ground level 30 feet from the building, the entire facade has been illuminated. The installation was the work of Benoit Taschereau of the British General Electric Company of Canada, Ltd., Quebec City, and placed third in the Quebec Chapter contest.

Sub-Station Yard—Victoria, British Columbia

Except to the initiated, sub-station transformer and switching yards are not normally civic beauty spots. The Bay Street Sub-Station of the British Columbia Electric Company in Victoria, before lighting, was no exception, but its night-time view has now become a cheerful landmark.

General lighting for lawns, shrubbery, parking areas and driveways has been provided by 400-watt mercury vapor units mounted on 30-foot hexagonal street lighting standards with transformer ballasts mounted remotely in the base of the poles.

Lighting for safety, and illumination on the transformer switching bus bars is from sub-station units mounted on the steel structure. These units are equipped with 500-watt lamps and located 8 feet above the ground in order to keep clear of the 60-kv bus work during relamping. The outer row of units have asymmetrical type distribution, others, symmetrical. Illumination is 8 footcandles at the center row, where previously it was necessary to carry a flashlight to check these contacts.

The layout is by A. S. Harris of the British Columbia Electric Co., and took second prize in Vancouver Island Chapter contest.

Color-Rendering of Fluorescent Lamps And Binocular Viewing Investigations

By G. T. WINCH
BRENDA M. YOUNG

Summarizing earlier work, this paper reviews progress since 1936 in techniques of measurement and specification of the color-rendering properties of electric discharge lamps, in particular fluorescent lamps. It first reviews the methods of measuring color-rendering properties in the objective sense and then deals with results of an investigation to subjective color-rendering, using a form of binocular viewing apparatus by means of which quantitative assessments of practical conditioning effects have been outlined. The implications of these data in relation to the design of decorations and lighting installations are indicated.

EARLIER WORK has shown that the colors of objects as seen by an observer are dependent on the spectral energy distribution, intensity and direction of the light incident on and reflected from objects, their relative position and angular subtense at the eye of the observer, and also the conditioning of the observer before and during observations. Provided these illuminating and viewing conditions are identical, colors of objects in the field of view will appear the same when illuminated by light sources having the same spectral energy distribution.

In an objective sense, therefore, it follows that the color-rendering properties of light sources can be defined by reference to their spectral energy distribution.

In a subjective sense, however, it is evident that the color-rendering properties of a light source are not uniquely defined by the spectral energy distribution, but are dependent also on the viewing conditions and the manner in which the eye of the observer has been conditioned before and during observation.

From the point of view of the specification of the color-rendering properties of light sources, in order to insure uniformity of performance it is clearly sufficient to specify the objective color-rendering properties in terms of spectral energy or luminance distribution, in complete or abridged form.

In order, however, to insure that in practical lighting installations the subjective color-rendering properties shall be acceptable, it is desirable that the architect, decorator and lighting engineer should take into account not only the objective color-rendering properties, but also the overall subjective color-rendering in order to achieve the best esthetic effect. This has earlier been shown by the authors[1] to be dependent on the following conditions:

(a) Class of task to be performed.
(b) Color and spectral distribution of the light source.
(c) Illumination and luminance levels.
(d) Color and spectral reflection of the decorations and effects of simultaneous color contrast.
(e) Conditioning of the observer prior to entering and while in the room having the particular lighting installation and decorations being appraised.
(f) Simultaneous comparison of the effect in a room with a particular form of lighting with that in adjacent rooms.
(g) Climatic background.

Objective Color-Rendering Properties

"Red Ratio"

The need for some means of measuring objective color-rendering of light sources first arose about 1934, when it was required to measure the improvement in the red color-rendering properties of high pressure mercury vapor lamps, due to the addition of cadmium. One of the authors (Winch) and Palmer[2] in 1934 described a simple method of determining the proportion of red light emitted by a source by measuring the lumens transmitted by a No. 25 red Wratten filter and expressing this as a percentage of the total lumens of the lamp. This was termed the "red ratio." The relative red rendering of high pressure mercury cadmium lamps with fluorescent outer bulbs is still frequently expressed in terms of "red ratio."

Abridged Spectrophotometry: C.I.E. Spectral Bands

As early as 1936 it was evident that the measurement of "red ratio" was inadequate as a means of specifying the color-rendering properties of low pressure mercury tubular fluorescent lamps in which about 90 per cent of the white light which they emit is contributed by radiation from the fluorescent powder and the remainder from the mercury lines.

In consequence of this situation, in about 1937, investigations were commenced in an attempt to find a commercial method of measuring and specifying the objective color-rendering properties of fluorescent and other electric discharge lamps. It was not practicable commercially to measure the complete spectral energy distribution as a routine, neither could the data from such measurements have readily formed the basis of color specifications, in view of the difficulty of stating objectives and tolerances on a complete curve. The possibilities of abridged spectrophotometry were, therefore, considered. In 1937 and 1939 Bouma[3] proposed that color-rendering should be expressed in terms of the relative luminance or luminous flux in eight defined adjacent spectral bands. He considered various numbers of bands and wavelength subdivisions. His choice of bands was determined by calculation, having in mind that it was not desirable to make a sub-division at a wavelength near one of these mer-

AUTHORS: Research Laboratories of The General Electric Company, Limited, Wembley, England.

cury-cadmium lines. This was partly for obvious practical reasons and partly because the eight spectral band method will be a more satisfactory index of color-rendering if spectral lines occur near the middle of a band than if they occur near its boundaries. In his calculations, Bouma determined the chromaticity coordinates of a hypothetical light source consisting of line radiation in which each line was at the center of each spectral band and the energy in each line was the same as that for Standard Illuminant A in each respective band. He then compared the chromaticity of this hypothetical source with that of Illuminant A, as determined for the various bands which he investigated. Those of his choice showed the least departure in chromaticity from that of Standard Illuminant A, which he regarded as a source having ideal color-rendering properties.

In view of Bouma's work in 1939, and the fact that World War II prevented any further immediate investigations, his recommended wavelength intervals were used during the war and subsequently by British and Dutch lamp makers, in conjunction with chromaticity coordinates, to specify the color-rendering properties of their lamps. The experience so gained led in 1948 to the adoption by the C.I.E. of Bouma's proposed spectral bands with the minor modification pressed for by other C.I.E. members, namely that the end bands should be extended to the limits of the visible spectrum. This resulted in the now familiar C.I.E. (1948) resolution:

"It is recommended:

(a) that the color rendering properties of illuminants should be measured and expressed in terms of:
  (i) chromaticity coordinates on the standard C.I.E. system;
  (ii) luminance in agreed spectral bands.

(b) that in view of established practice the spectral bands used in (a) above should provisionally be as follows:

Band No.	Wavelength Limits
1	380 to 420μ
2	420 to 440μ
3	440 to 460μ
4	460 to 510μ
5	510 to 560μ
6	560 to 610μ
7	610 to 660μ
8	660 to 760μ

(c) that methods of appraising color rendering properties, including con-

TABLE I.—Division of Visible Spectrum into Nine Bands as Proposed by Taylor.

Band	Wavelength Limits
1	0.3950 to 0.4340μ
2	0.4340 to 0.4775μ
3	0.4775 to 0.4980μ
4	0.4980 to 0.5285μ
5	0.5285 to 0.5690μ
6	0.5690 to 0.5900μ
7	0.5900 to 0.6185μ
8	0.6185 to 0.6415μ
9	0.6415 to 0.7050μ

TABLE II.—Division of Visible Spectrum into Eight Bands as Proposed by le Grand.

Band	Wavelength Limits
1	0.41 to 0.44μ
2	0.44 to 0.46μ
3	0.46 to 0.50μ
4	0.50 to 0.54μ
5	0.54 to 0.57μ
6	0.57 to 0.60μ
7	0.60 to 0.63μ
8	0.63 to 0.67μ

TABLE III.—Division of Visible Spectrum into Eight Bands as Proposed by Tarnay.

Band	Wavelength Limits	Wavelength Limits (Rounded off by Tarnay)
1	0.410 to 0.437μ	0.41 to 0.44μ
2	0.437 to 0.454μ	0.44 to 0.46μ
3	0.454 to 0.478μ	0.46 to 0.48μ
4	0.478 to 0.529μ	0.48 to 0.53μ
5	0.529 to 0.559μ	0.53 to 0.56μ
6	0.559 to 0.584μ	0.56 to 0.58μ
7	0.584 to 0.610μ	0.58 to 0.61μ
8	0.610 to 0.670μ	0.61 to 0.67μ

TABLE IV.—Alternative Spectral Bands Proposed by Kruithof.

7-Band System	8-Band System
380 - 445μ	380 - 445μ
445 - 485μ	445 - 470μ
485 - 525μ	470 - 500μ
525 - 560μ	500 - 530μ
560 - 595μ	530 - 560μ
595 - 625μ	560 - 595μ
625 - 750μ	595 - 625μ
	625 - 750μ

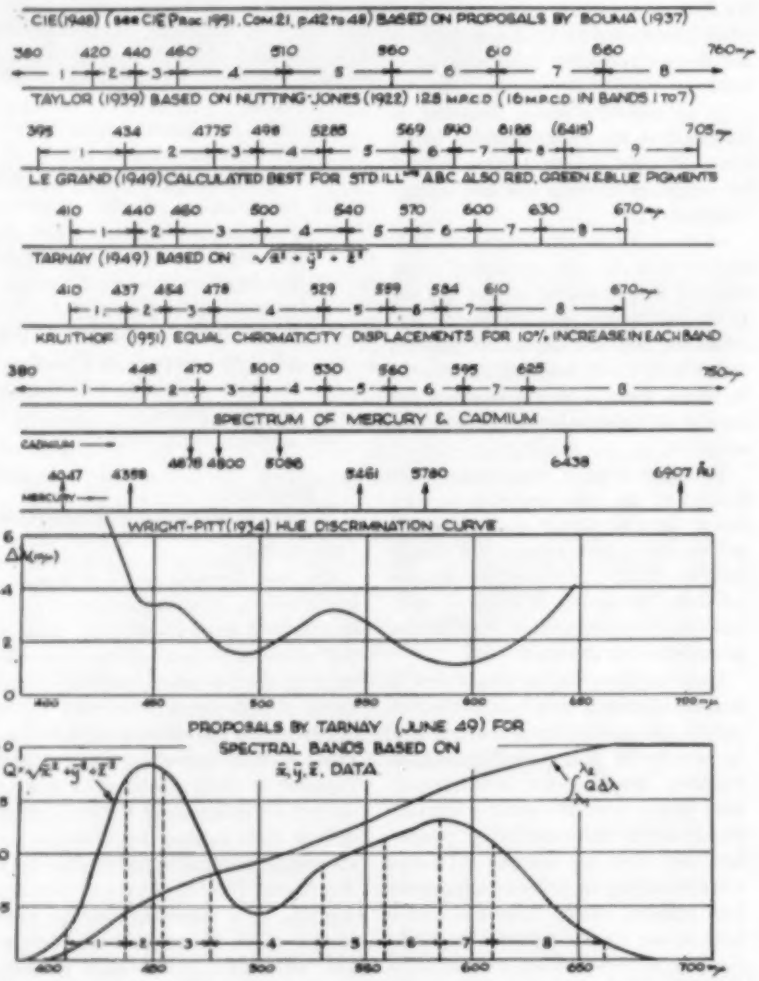

C.I.E.(1948) (see C.I.E. Proc. 1951, Com 21, p42 to 48) BASED ON PROPOSALS BY BOUMA (1937)
380 420 440 460 510 560 610 660 760mμ
TAYLOR (1939) BASED ON NUTTING-JONES (1922) 12.8 M.P.C.D (16 M.P.C.D. IN BANDS 1 TO 7)
395 434 4775 498 5285 569 590 6186 (6415) 705mμ
LE GRAND (1949) CALCULATED BEST FOR STD ILL^NTS A,B,C. ALSO RED, GREEN & BLUE PIGMENTS
410 440 460 500 540 570 600 630 670mμ
TARNAY (1949) BASED ON √x̄² + ȳ² + z̄²
410 437 454 478 529 559 584 610 670mμ
KRUITHOF (1951) EQUAL CHROMATICITY DISPLACEMENTS FOR 10% INCREASE IN EACH BAND
380 448 470 500 530 560 595 625 750mμ
SPECTRUM OF MERCURY & CADMIUM
CADMIUM
4678 4800 5086 6438
4047 4358 5461 5780 6907 Å.U.
MERCURY
WRIGHT-PITT (1934) HUE DISCRIMINATION CURVE
Δλ(mμ)
6
4
2
0
400 460 500 560 600 660 700mμ
PROPOSALS BY TARNAY (JUNE 49) FOR SPECTRAL BANDS BASED ON x̄, ȳ, z̄, DATA
Q = √x̄² + ȳ² + z̄²
∫ Q dλ
2.0
1.5
1.0
0.5
1 2 3 4 5 6 7 8
400 460 500 560 600 660 700mμ

Figure 1. C.I.E. and other proposed spectral bands for specifying color-rendering properties.

firmation of the best spectral band intervals, should be further explored by National Committees."

Apparatus has been described[4,5] with which measurements of chromaticity and spectral bands can be readily carried out on fluorescent lamps. Provisional color and color-rendering specifications for these lamps have been used based on such measurements.

Recent investigations by the authors have shown that, provided substitutional methods of calibration are used, these color and color-rendering characteristics can be measured to an accuracy sufficient for many commercial purposes by means of selenium photovoltaic cells in conjunction with a series of filters. A brief description of this method is included in the appendix to the present paper, as this technique has not previously been described.

Other Proposed Spectral Bands

Other spectral bands have been proposed, as indicated in C.I.E. Proceedings 1951, 1, p. 21-47, but it would appear that the practical difficulties associated with the need for avoiding at the sub-divisions coincidence with, or close proximity to, the mercury and cadmium lines, had not always been considered.

In 1939-1940 Taylor[6] proposed the nine bands shown in Table I. These intervals were arrived at by dividing the visible spectrum into adjacent sections, each of sixteen minimum perceptible color steps as defined by Nutting and Jones,[7] who had indicated that there are 128 just perceptible color differences in the visible spectrum. Starting from the blue end of the spectrum, this method of sub-division was used to obtain the bands 1 to 7, while the intervals of bands 8 and 9 each embraced only eight minimum perceptible color steps.

In 1949 le Grand[8] proposed the eight bands as indicated in Table II. He had considered the C.I.E. eight bands and from calculations using the 30 selected ordinates by Bowditch and Mull found that on this basis the distribution of the bands was irregular and he claimed that the two extreme bands were hardly of any use. He, therefore, proposed the eight new bands in Table II. In order to compare the relative merits of the C.I.E. and his proposed spectral bands he calculated from the luminance in these spectral bands the chromaticity coordinates and luminance factors of Standard Illuminants A, B and C, and also for light reflected from vermilion red, emerald green and French ultra-marine blue paints when illuminated by an equal energy source. From a comparison with the true values of the chromaticities and luminance factors calculated from the spectral band data, le Grand indicates that in these six cases the discrepancies for his proposed new bands are much smaller, and, therefore, his bands are preferable to the C.I.E. bands. He has not, however, considered light sources of the discharge lamp type.

In July 1949 Tarnay, in a confidential report, suggested an alternative spectral band sub-division of eight bands as indicated in Table III. These he arrived at by first calculating a curve which he indicated was related to the coloring power of monochromatic radiations. This curve was derived from the root mean square of the $\bar{x}$, $\bar{y}$, $\bar{z}$ coefficients of the C.I.E. colorimetric system. From this curve he calculated eight adjacent spectral bands which embrace equal areas under the curve. As the sub-division proposed by Tarnay is based on the root mean square of the $\bar{x}, \bar{y}, \bar{z}$ distribution curves, it would appear that this weighting is not the most suitable as it is related to the non-uniform chromaticity C.I.E. system. If it were based on a uniform chromaticity system it would be expected that the divisions proposed would be related to those based on equal discrimination steps.

At the C.I.E. meetings in 1951 Kruithof[9] proposed alternative spectral bands, which are given in Table IV.

These bands were determined by calculation, on the basis of equal displacements of chromaticity in terms of the radius vector of MacAdams m.p.c.d. ellipse in the direction of the displacement, for a 10 per cent energy increase applied successively to all the bands. These have been corrected so that the most prominent mercury lines are near the center of their bands. On this basis a seven and an eight band system were proposed, but the calculations indicated that eight bands provided the best sub-division.

Comparison of Proposed Spectral Bands

Fig. 1 shows the relative sub-divisions of the spectrum as proposed by Taylor, le Grand, Tarnay and Kruithof in relation to the C.I.E. bands. In addition, for comparison purposes, the Wright-Pitt[10] hue discrimination curve and the Tarnay color weighting curve are included.

It will be seen by inspection of Fig. 1 that, in the C.I.E. bands the mercury and cadmium lines are distant from the spectral sub-divisions by amounts sufficient to avoid errors due to light at the edge of the line images spreading over into an adjacent band. In some cases the divisions proposed as alternatives tend to coincide with or to be too near the spectral lines. Comparison of the Tarnay color weighting curve with the Wright-Pitt hue discrimination curve confirms the expectation that it is not a suitable method of weighting results which are to be related to the objective color-rendering properties. There are appreciable discrepancies between the hue discrimination curves of Nutting and Jones as compared with Wright and Pitt, so that the spectral band sub-divisions proposed by Taylor would not be the same as a series calculated from the Wright-Pitt data. The le Grand sub-division has only been considered in relation to Standard Illuminants A, B and C and red, green and blue pigments.

It would seem that if any alternative to the present C.I.E. bands are to be considered they must satisfy the following requirements.

(a) Avoidance of coincidence or close proximity of the spectral band divisions to the spectral lines.

(b) It would seem desirable, if practicable, to base the sub-division on equal numbers of discrimination steps in each spectral band interval, but it is questionable which discrimination data should be used for this purpose.

(c) It is essential that any proposals, however theoretically desirable, must be such that they can be realized in a practical instrument suitable for routine commercial measurement by non-scientific operators. It was for such practical reasons that in the C.I.E. (1948) color-rendering resolution, chromaticity measurements are required to be made in addition to measurements of relative luminance in the eight spectral bands. In

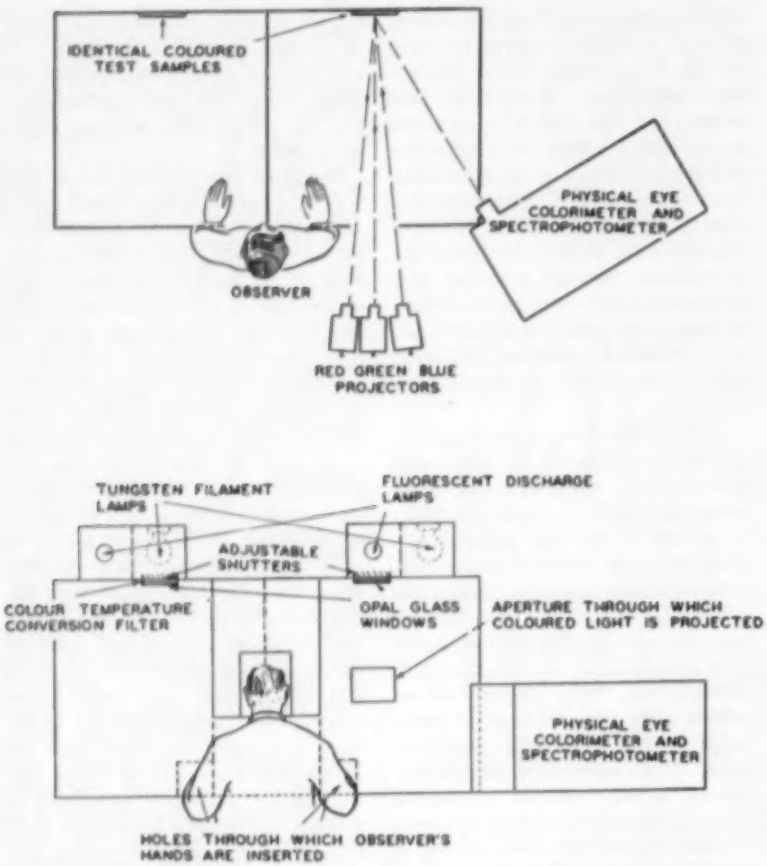

IDENTICAL COLOURED TEST SAMPLES
PHYSICAL EYE COLORIMETER AND SPECTROPHOTOMETER
OBSERVER
RED GREEN BLUE PROJECTORS
TUNGSTEN FILAMENT LAMPS
FLUORESCENT DISCHARGE LAMPS
ADJUSTABLE SHUTTERS
COLOUR TEMPERATURE CONVERSION FILTER
OPAL GLASS WINDOWS
APERTURE THROUGH WHICH COLOURED LIGHT IS PROJECTED
PHYSICAL EYE COLORIMETER AND SPECTROPHOTOMETER
HOLES THROUGH WHICH OBSERVER'S HANDS ARE INSERTED

Figure 2. Binocular viewer: (above) horizontal section; (below) front elevation.

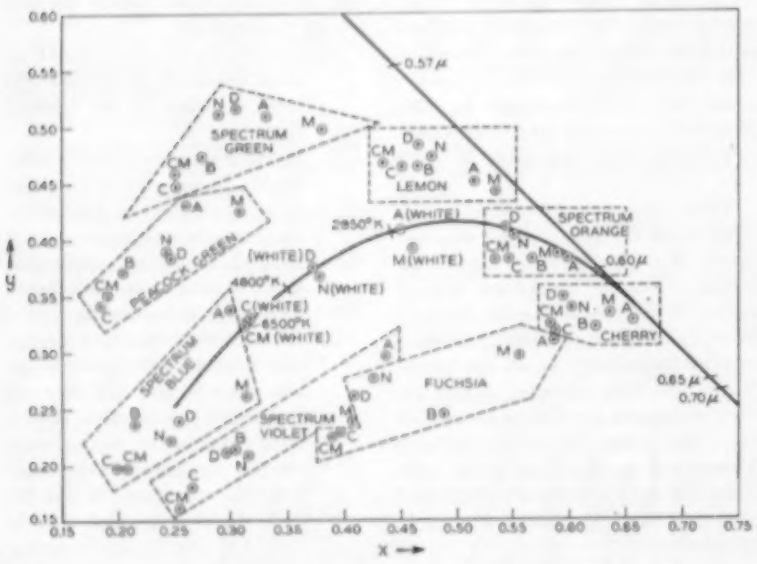


Figure 3. Chromaticity diagram showing C.I.E. chromaticity coordinates of samples under various illuminants. A — Std. Illum. A, 2850K; B — Std. Illum. B, approx. 4800K; C — Std. Illum. C, approx. 6500K; D — 80-watt daylight MCF/U; N — 80-watt natural MCF/U; M — 80-watt mellow MCF/U; CM — 80-watt color matching MCF/U.

some instruments of the type otherwise suitable, the accuracy which can be achieved in commercial determinations of the relative luminance in the spectral bands is not sufficient by itself, but when combined with chromaticity measurements, which are required in any case, enables the necessary accuracy to be achieved.

(d) No alternative spectral bands can be seriously considered until a large amount of measurement data is available on all types of light sources concerned, so that they can be analyzed to find the extent to which practical results support the theoretical expectation.

Other Proposed Objective Methods

Jerome and Judd[11] in 1950 proposed methods of measuring color-rendering properties by reference to metameric pairs, and somewhat similar suggestions have been put forward also by Harrison[12] in 1951. In addition, Henderson and Waigh[13] have suggested the classification of color-rendering properties by reference to a color index based on the proportion of light in the red end of the spectrum. This proposal is very similar to the "red ratio" method first used in 1934.[2]

The limitations to these methods would seem to be that they do not uniquely define the color and color-rendering properties even in the objective sense.

Subjective Color-Rendering Properties: Binocular Viewing

In view of the limited data available on the subjective aspect of color-rendering and the need for such information to guide the architect, decorator and lighting engineer, since 1949 the authors[14] have carried out some investigations in this field.

Binocular Viewer

The very interesting results reported earlier by Wright,[15] Hunt[16] and others, each using his particular forms of binocular viewing apparatus inspired the present authors to apply a binocular viewing technique in investigations into the subjective color-rendering properties of light sources, including tubular fluorescent electric discharge lamps. A full description of this work

has already been published in detail elsewhere[1] but a brief summary is given below.

The special binocular viewing apparatus used in this work was designed to simulate as nearly as possible the conditions of view obtaining when an observer is in a room illuminated by a laylight in the ceiling. The form of this apparatus is shown diagrammatically in Fig. 2. It will be seen that each eye of the observer has a direct view of one of a pair of identical colored material test samples, each about 7 inches square, and about 3 feet 6 inches from the observer's eyes, so that they subtend an angle of about 9 degrees. The two adjacent cabinets can be illuminated by tungsten filament lamps to provide Standard Illuminant A, while by means of temperature conversion filters Standard Illuminants B or C can be simulated. Alternatively, fluorescent lamps of any desired color, or natural north light can be used as sources, the latter by removing the lamp housing from the top of the apparatus which stands under a north skylight. Venetian shutters between the light sources and the opal glass panel in the roof of the cabinet allow for adjustment of the illumination level in each cabinet. The fronts of the cabinets are hinged so that they can be opened to allow food or other test objects to be placed in the cabinet. Apertures are also provided so that the observer can put his hands in the compartments to view the color-rendering of the flesh. The inner walls and floor and ceiling of the compartments are covered by detachable panels so that they can be changed and different decoration effects simulated. Three projectors outside the right hand cabinet can be used when required to project any desired mixture of colored light onto the colored test patches and the photoelectric Physical Eye Colorimeter and Spectrophotometer on the right of the apparatus can be used to measure the chromaticity of the test patches.

Binocular Viewing Techniques

The following observing technique was used with the apparatus described in the previous section.* The observers used in these binocular comparisons were first tested to make sure that, within the accuracy of measurement, the color response of both eyes was the same.

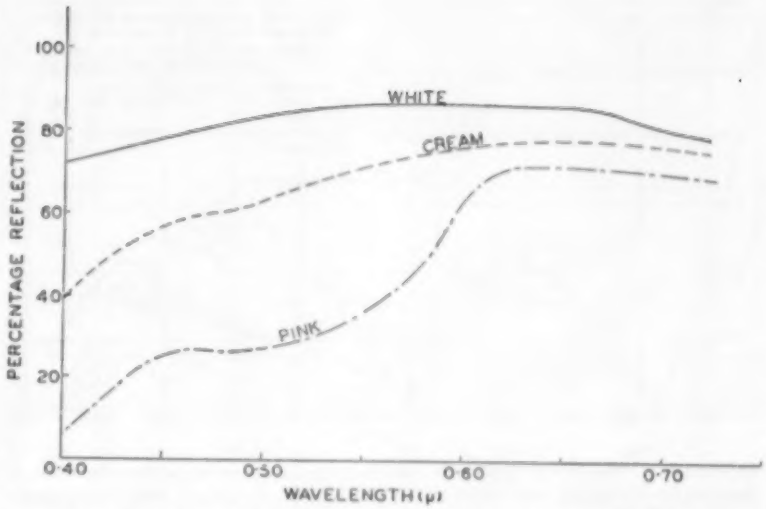
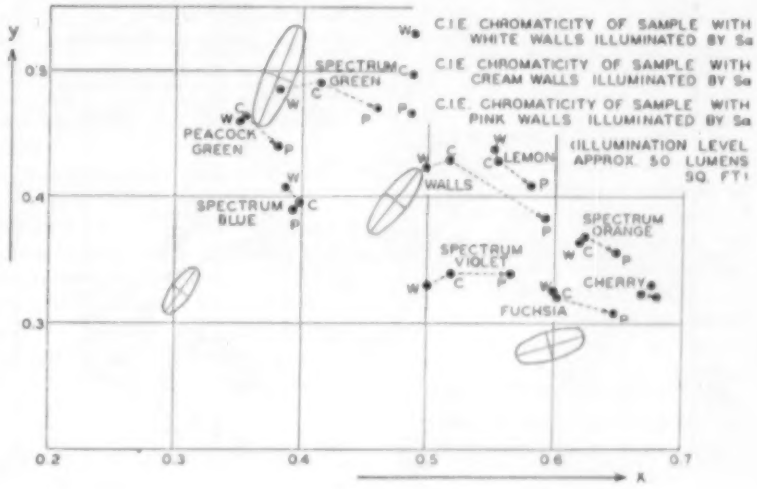


Figure 4. (above) Spectral reflection curves in binocular viewer; (below) chromaticity diagram showing change in chromaticity of colored samples in binocular viewer illuminated by tungsten light S_A, due to differently colored walls.

(Note: The color appearance of test samples under simultaneous contrast conditions is indicated by the points W and P. Ellipses are ± 10 M P C D in Macadam System.)



When required, simultaneous comparisons of both test patches and surrounds are made by the observer standing back from the apparatus and viewing through the central aperture.

The binocular viewing technique, for which the apparatus was mainly designed, consists in the observer looking through the central aperture with his head close to the partition, so that each eye sees only one cabinet. The observer is asked not to fixate on the test patches but to allow his eyes to scan the field of view in the random manner in which he would if in an illuminated room. The final comparison is made in quick succession with the left and right eyes by closing and opening each eye alternately.

When the light sources above each cabinet are different in objective color-rendering properties the colored test patches will, in general, at first appear to be different in color, as also will the surrounding walls. After conditioning, however, the color difference between the test patches will be considerably reduced. By the addition of the appropriate mixture of colored light from the three projectors the test patch in the right hand cabinet can usually be made to appear a color match with that on the left. The chromaticity of the right hand patch is then measured

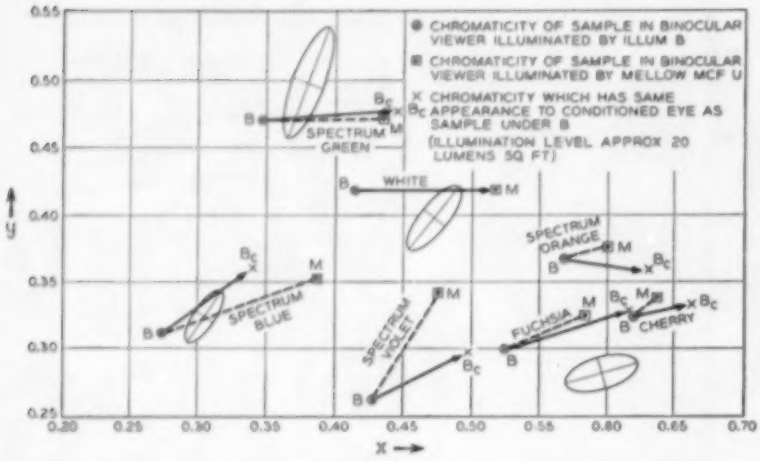
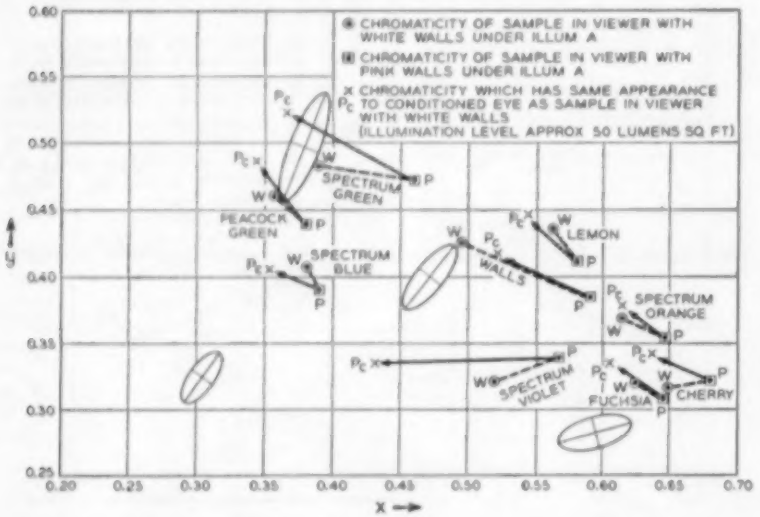

CHROMATICITY OF SAMPLE IN BINOCULAR VIEWER ILLUMINATED BY ILLUM B
CHROMATICITY OF SAMPLE IN BINOCULAR VIEWER ILLUMINATED BY MELLOW MCF U
CHROMATICITY WHICH HAS SAME APPEARANCE TO CONDITIONED EYE AS SAMPLE UNDER B
(ILLUMINATION LEVEL APPROX 20 LUMENS SQ FT)
SPECTRUM GREEN
WHITE
SPECTRUM ORANGE
SPECTRUM BLUE
SPECTRUM VIOLET
FUCHSIA
CHERRY
y
x

Figure 5. (above) Chromaticity diagram showing change of appearance of colored samples by change of conditioning from daylight S_B to mellow MCF/U; (below) chromaticity diagram showing change of color appearance of colored samples due to change of conditioning from white walls to pink walls.

(Note: The color appearance of test samples under simultaneous contrast conditions is indicated in drawing above by points B and M; in drawing below by points W and P. Ellipses are ± 10 M P C D in Macadam System.)


CHROMATICITY OF SAMPLE IN VIEWER WITH WHITE WALLS UNDER ILLUM A
CHROMATICITY OF SAMPLE IN VIEWER WITH PINK WALLS UNDER ILLUM A
CHROMATICITY WHICH HAS SAME APPEARANCE TO CONDITIONED EYE AS SAMPLE IN VIEWER WITH WHITE WALLS
(ILLUMINATION LEVEL APPROX 50 LUMENS SQ FT)
SPECTRUM GREEN
PEACOCK GREEN
SPECTRUM BLUE
LEMON
WALLS
SPECTRUM ORANGE
SPECTRUM VIOLET
FUCHSIA
CHERRY
y
x

with and without the added colored light. These values give an objective measure of the subjective color change observed.

Results and Discussion

As indicated earlier, detailed results of the investigations carried out with the binocular viewer are published elsewhere but a summary of the results is given below.

Objective Color-Rendering

Fig. 3 shows the objective chromaticities of the colored fabric samples used in the quantitative investigations, when illuminated by various light sources. This shows the extent of the objective chromaticity shift produced by each given light source and represents the color difference which can be observed by simultaneous comparison.

Colored Walls: Objective and Subjective Effects

Fig. 4. gives the spectral reflection curves of the white, cream and pink detachable panels used in the binocular viewer. The chromaticity diagram shows the extent to which the objective chromaticity of the colored fabric samples is altered by interreflections from the different colored wall panels although the cabinets are illuminated by the same light source.

When the binocular viewer was used with one cabinet lined with white panels and one lined with pink panels but using the same illuminant, it was found that, after conditioning, residual color differences of the test samples were observed which were of the same magnitude as occurred after conditioning when comparing certain light sources of different spectral distributions, but with both cabinets lined with panels of the same color.

As an example of this effect Fig. 5 shows the extent of these differences compared with the effects observed when comparing mellow fluorescent lamps with Standard Illuminant B. This gives an indication of the extent to which the color-rendering can be influenced by colored decorations and furnishings, such as frequently occur in practice.

Subjective Conditioning Effects with Different Light Sources

It was shown quantitatively that there is a large measure of compensation by conditioning in the subjective color-rendering observed under light sources such as Standard Illuminants A, B and C. The resultant effect is that colored objects and materials do not appear so different in color under these illuminants as would be indicated by the chromaticity coordinates. Even when compensation due to conditioning is not complete, the color-rendering differences are not objectionable in these cases which confirms practical experience. This was also confirmed qualitatively, by observation of common foods and the complexion. The appearance of these common objects under these illuminants after conditioning was considered acceptable. There appeared to be a measure of absolute color sense for these common objects which was consistent with their color appearance under Standard Illuminants A, B and C.

From the experiments in the binocular viewer, it was shown quantitatively, however, that when comparing Standard Illuminants A, B or C, with fluorescent lamps, there was not the same measure of compensation in some cases after conditioning, and larger residual color differences were still observed than was the case when comparing daylight or other full radiation sources such as tungsten lamps with each other. This again confirms general experience and may be due to the particular characteristics of the contribu-

tion from the mercury lines which, even after conditioning, give unfamiliar color-rendering of certain pigments.

It was found that when the spectral energy curve of the fluorescent lamp more nearly approached a regular form of spectral distribution, such as that of a full radiator, then the eye seems able to compensate for larger differences, by conditioning.

Specifications of Color-Rendering Properties

The findings would appear to confirm the desirability of including abridged or complete spectral energy or luminance distribution data in a color-rendering specification, particularly for sources of irregular spectral luminance distribution. This can be done by objective measurement of the spectral energy distribution curve, or, for convenience as in the C.I.E. system, by a spectral band method. The bands, however, should preferably be so chosen that the wavelength intervals embrace no more than the number of m.p.e.d for which it is known the eye can compensate by conditioning. This has been shown by the binocular viewing experiments to be about 20-30 m.p.e.d. (MacAdam) over the range of colors investigated for sources of regular spectral distribution.

The tolerances which should be put on the energy or luminance in these bands will depend upon the application in which the particular light source is to be used, *e.g.* social lighting, office or industrial lighting or color matching. This could be determined to a limited extent from the results of the binocular viewing experiments which have been carried out. Further work is continuing to investigate subjectively the number of bands necessary to discriminate color-rendering at each end of the spectrum, having in mind the contribution of the mercury lines at 0.4047μ and 0.4358μ, and the differences in phosphors in the red region in the fluorescent lamp spectrum. This work is only in its preliminary stages but Fig. 6 shows reflection curves of some commonly available dyed fabrics which are being used in this investigation because their spectral reflectivity curves rise sharply at the ends of the spectrum. It is understood that a detailed study of this aspect of the work is being carried out at the National Physical Laboratory, Teddington, England, where determinations are being made

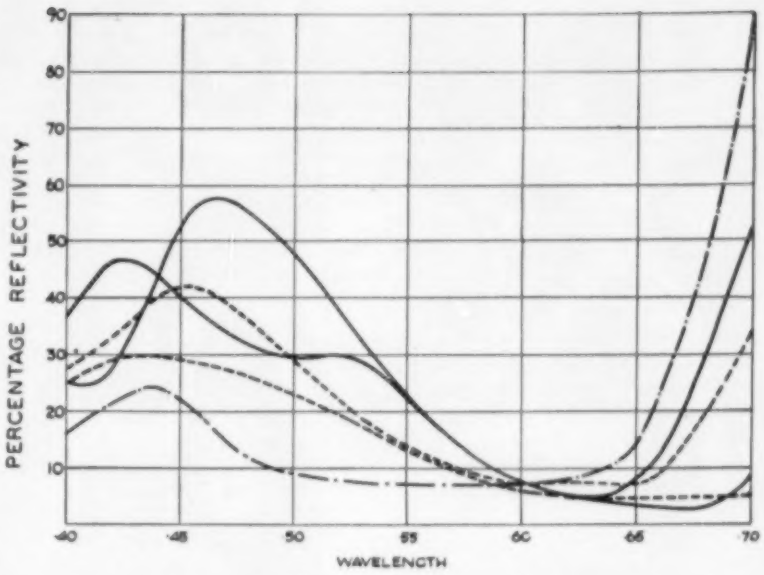


Figure 6. Spectral reflection curves on blue and purple silk and wool samples.

of the extent to which the amount contributed to the spectral band intervals chosen for specification purposes can be altered relative to each other without producing undesirable color-rendering.

In the absence of these data, working tolerances[5] based on measurement experience have been in use for some years in provisional specifications for color and color-rendering of tubular fluorescent lamps. These tolerances are ±5 per cent for C.I.E. spectral bands 5 and 6; ±10 per cent for bands 2, 3, 4 and 7; and ±20 per cent for bands 1 and 8.

Conclusions

Objective Color-Rendering

It is shown that apparatus and methods of measurement have been developed which enable the color and color-rendering properties of light sources, particularly fluorescent lamps, to be measured and specified in the objective sense. This is the basis of the C.I.E. (1948) recommendations (a) and (b), which recommend that these characteristics should be measured in terms of chromaticity coupled with the relative luminance in eight agreed spectral bands.

Concerning the C.I.E. recommendation (c), the present paper refers to proposals which have been made for modifying the existing spectral band intervals. In this connection the authors stress that any proposals for modification to the present intervals should meet the following requirements.

(a) The spectral bands should contain equal numbers of m.p.e.d. in relation to a discrimination curve determined from observations with a large field. The obvious choice for the discrimination curve used would be that which it is expected will result from the work now believed to be in hand at the National Physical Laboratory, Teddington, in connection with the redetermination of the mixture data, for the 1955 C.I.E. meetings.

(b) The number of spectral bands should, if possible, not exceed eight, provided this results in the chosen intervals embracing no more than 20 to 30 m.p.e.d. (MacAdam) as the authors have indicated is desirable from the binocular comparisons.

(c) Some adjustments to theoretically desirable spectral band intervals may be necessary to avoid coincidence with spectral lines in the sources concerned.

(d) It is still considered desirable to couple the spectral band requirements with chromaticity data on the source.

(e) No modified proposals for a new system should be put forward until measurements have been made with that new system on a sufficient number of lamps to confirm by experience, that the the new system is, in fact, preferable in all respects to the existing 1948 C.I.E. system.

Subjective Color-Rendering

The investigations which have been carried out using a special binocular viewing technique give quantitative indications of the extent to which color-rendering in a subjective sense is dependent on the conditioning of the observer due to the following causes.

(a) Color and spectral distribution of the light source.
(b) Illumination and luminance levels.
(c) Color and spectral reflection of the decorations and effects of simultaneous color contrast.
(d) Conditioning of the observer prior to entering and while in the room having the particular lighting installation and decorations being appraised.
(e) Simultaneous comparison of the lighting installation with that in adjacent rooms.

These subjective investigations are far from complete but the data available to date give some indication of the controlling factors which influence color-rendering in practical viewing conditions.

There may also be other factors which influence the subjective judgment, such as

(f) Class of task to be performed.
(g) Climatic background.

Appendix — Approximate Method of Measuring Chromaticity and Spectral Bands

The results of experiments and measurements show that with commercially available selenium photovoltaic cells and certain color filters in appropriate combination, measurements of color and color-rendering properties can be carried out to an accuracy sufficient for some commercial purposes, provided sources of similar spectral distribution are used in calibration.

Approximate method of measuring chromaticity

Approximate measurements of chromaticity can be made by means of Dufay-Chromex gelatine filters, Nos. 692, 693 and 694, used in turn, in front of a selenium photovoltaic cell. Measurements should be made with these photocell-filter combinations arranged at a distance of not less than 6 inches from the central 6 inches of the tubular fluorescent lamp. Substitutional calibration should first be carried out by measuring one or more fluorescent tubes of the same color name and manufacture as that of the lamps to be measured, which have been calibrated for chromaticity by the National Physical Laboratory or other competent standardizing laboratory. From the ratio of the measurements made in this manner through each of the filters, Nos. 692, 693 and 694 the chromaticity of the test lamps can be calculated as indicated in the following example. Where P_{692}, P_{693} and P_{694} are the currents from the photovoltaic cell when used, respectively with filters 692, 693 and 694.

$$\frac{P_{692} \text{ for test lamp}}{P_{692} \text{ for calibrated lamp}} \times \text{true } x \text{ value} = \text{test lamp } x \text{ value, approximately.}$$

The approximate y and z measurements and values can be obtained by a similar calculation from the P_{693} and P_{694} values. If, as is probable, these three values do not sum exactly to unity the ratio of each to the sum should be calculated to obtain the corrected x, y and z values.

Approximate method of measuring spectral bands

A selenium photovoltaic cell and Ilford filters, Nos. 601, 603, 604 + 605, 606, 607 and 608 can be used to measure the luminance in spectral bands by reference to an N.P.L. calibrated fluorescent lamp of the same color name. From the results of such measurements the percentage luminance in the bands, can be derived as follows:

Ilford spectral filter number*	Equivalent C.I.E. spectral band
601	1, 2 and 3
603	4
604+605	5
606	6
607	7
608	8

The filters detailed above should be used in turn over the photocell to make measurements on the central parts of the fluorescent tubes in the manner of the measurements with the Dufay-Chromex filters. The luminance in spectral bands is then calculated by reference to the calibrated lamp by similar simple calculations for the determination of the chromaticity values. If the measured spectral band values do not sum to unity, they should be adjusted in a manner similar to that described for the chromaticity values.

Accuracy of Measurement

Chromaticity measurements can be made directly in the C.I.E. system using Dufay-Chromex filters Nos. 692, 693 and 694 and test results show that an accuracy of 0.003 in the chromaticity values can be obtained by this method when measuring fluorescent tubes of Color Matching, Daylight, Natural, Warm White and Mellow colors. A similar accuracy can be achieved when measuring the chromaticity of light transmitted by color filters.

Measurements of color-rendering properties of fluorescent tubes can be carried out using Ilford spectrum filters Nos. 601, 603, 604, 605, 606, 607 and 608. The tests confirm that the results so obtained are consistent with the spectral luminance values in the C.I.E. spectral bands.

Photometric measurements can be made using the Dufay-Chromex filter No. 693, but spectral transmission and direct photometric measurements show that the approximation to the C.I.E. $\bar{y}$ or "Average Eye" response is not so good as that obtained with Chance OY12 glass filters of appropriate thickness or with the individually matched three component glass filters obtainable from the British Scientific Instrument Research Association.

*Experiments have been made with these filters which have proved satisfactory. It is possible that filter 607 may be a suitable alternative for 604 + 605.

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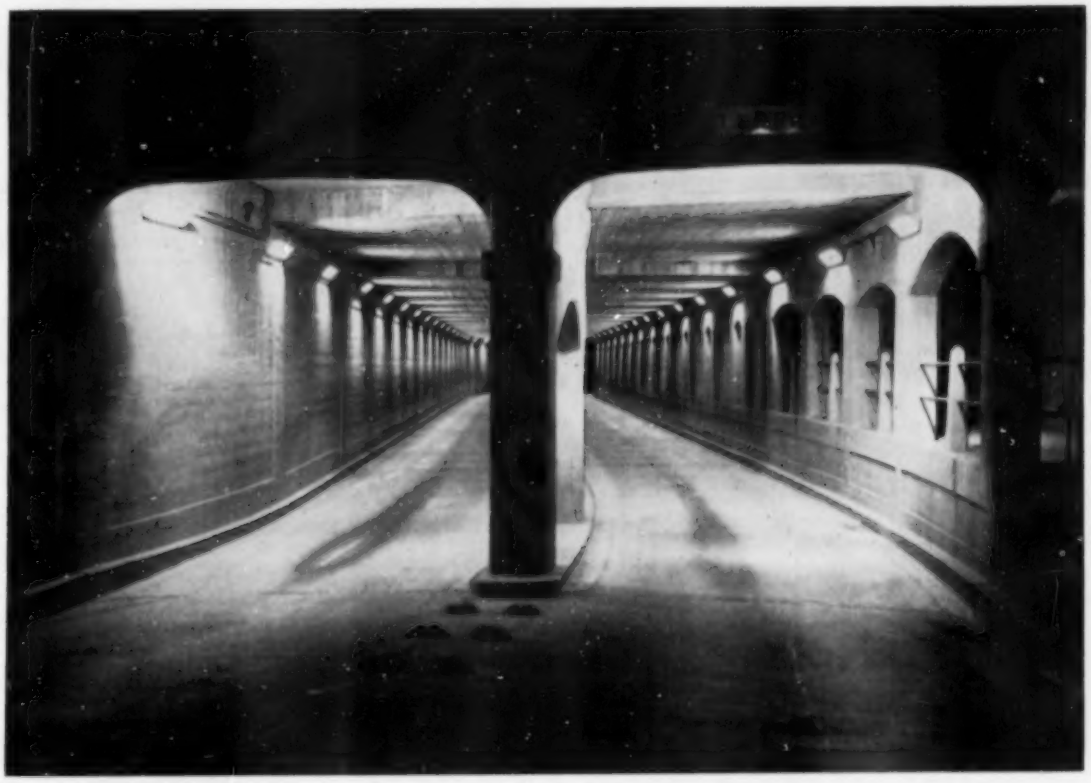


INSTALLATION AT GOOD STREET UNDERPASS — WEST TUNNEL, DALLAS, TEXAS.

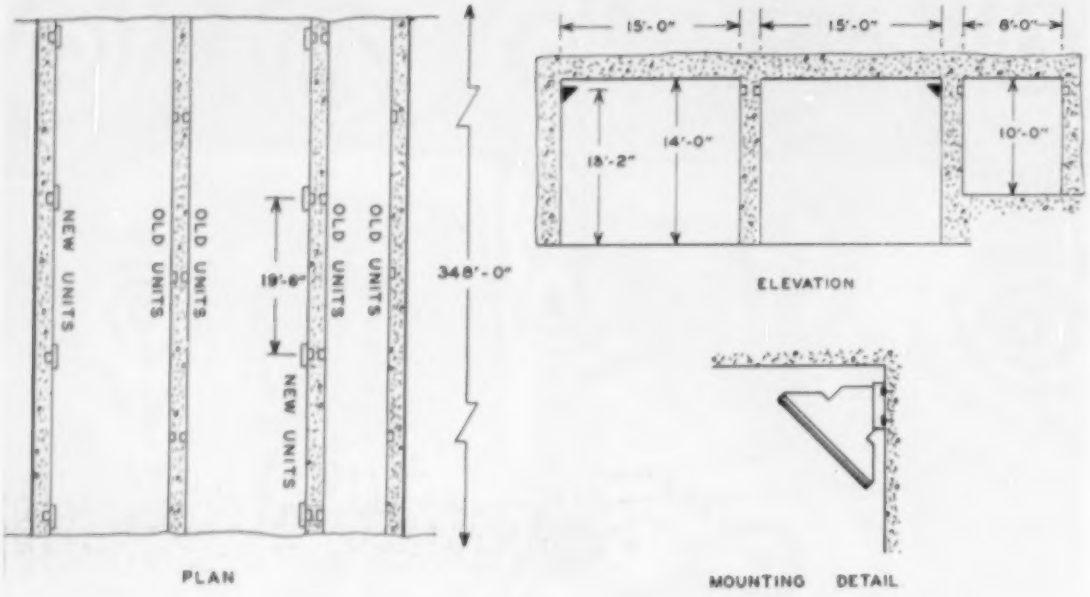
Lighting a Street Underpass

LIGHTING OBJECTIVE: To relight an underpass to handle increased traffic and match the lighting in a new parallel adjacent tunnel.

GENERAL INFORMATION: The underpass is 348 feet long, 14 feet high and has a flat ceiling with no exposed beams. There are three separate lanes: two 15-foot lanes for vehicles and one lane 8 feet wide for pedestrians. The underpass is of concrete construction originally made smooth by wetting and rubbing with a carborundum block. All surfaces are unpainted concrete that has weathered for twenty-five years and now has reflection factors of about 15 to 20 per cent. Because of darkening of the concrete with age and the use of 92-watt lamps instead of the original 150-watt lamps in the Benjamin recessed pits units, the illumination had fallen off from the original 3 footcandles to 1 footcandle in 1954.

(over)

A.I.A. File No. 31-f



INSTALLATION: The old incandescent units were installed on both sides of each lane, a total of 70 150-watt units for the roadway and 35 for the walkway. The outside row of units on each traffic lane (a total of 34) were replaced by Benjamin catalog no. 49532 "Angle Vaportight 40" twin-lamp TPG units on 19-foot 6-inch centers. Each of these units uses two 40-watt T-12 standard cool white preheat start fluorescent lamps. The remaining Benjamin recessed pits units, which are still in use, are equipped with 92-watt A-23 group replacement multiple street lighting lamps. The illumination is approximately 6 footcandles on the roadway at the center island.

Lighting designed by Mr. M. D. Darrah, Chief Electrical Inspector of the City of Dallas, Dallas, Texas.

Lighting data submitted by Ruth Patterson, Dallas Power and Light Company, Dallas, Texas, as an illustration of good lighting practice and to aid in the design of similar installations.

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TELECAST

LIGHTING NEWS OF CURRENT INTEREST

Summary of Action June Council Meeting Held at Lake George, N. Y.

For the second time this year, Council scheduled a meeting outside of New York, holding its June meeting at the Fort William Henry Hotel, in Lake George, N. Y. The Council meeting preceded the Northeastern Regional Conference scheduled there June 10 and 11. There was almost record attendance, with 32 present, as follows: President, Duncan M. Jones; Past Presidents E. M. Strong and A. H. Manwaring; Vice-Presidents, R. F. Hartenstein and M. N. Waterman; General Secretary K. M. Reid; Treasurer G. J. Taylor; Directors, C. C. Shotwell, W. A. Stannard, L. C. Twichell, S. H. Hazleton proxy for J. S. Walsh, J. F. Whitehead, Jr., F. C. Winkler; Regional Vice-Presidents, W. P. Lowell, Jr., proxy for J. R. Chambers, Joseph Thomas proxy for M. B. Hastings, C. W. McCormick, M. J. Myers, Jr., G. E. Park, G. G. Rae proxy for B. E. Plowman, A. C. Sangster; Executive Secretary, A. D. Hinckley; Editor, Ruby Redford; Advertising and Promotion Manager, C. E. Ellis; and Willard Allphin, Brooks Chassaing, George D. Clayton, H. M. Doyle, H. H. Friedman, J. J. Neidhart, L. G. Parks, R. H. Rice, and C. E. Waldron.

New Members

The Board of Examiners reported the election of 89 Asociate Members and 3 Student Members (whose names are listed at the end of this issue of Lighting News) and recommended the election of 12 full Members. Favorable action of Council on these elections and recommendations resulted in a current membership figure as shown in the tabulation below:

September 30, 1954		June 9, 1955
7902	Total Membership	8492
34	Members Emeritus	35*
78	Fellows	78
1939	Members	2027
5621	Associate Members	6116
230	Student Members	236

*Includes 12 Fellows.

Sustaining Members

Following a Progress Report to Council on current studies of Sustaining Membership activities, Mr. C. C. Shotwell, Chairman, recommended the election of three new Sustaining Members. These are:

Lighting Services
63 Bank Street
Waterbury, Conn.
Official Representative: Francis Clark

Public Service Co. of New Mexico
P. O. Box 1360
Albuquerque, N. M.
Official Representative: Stanley Bazant, Jr.

The Nova Scotia Power Commission
Halifax, N. S.
Official Representative: A. T. Dean

Regional Activities

Marshall Waterman, Chairman for Regional Activities, reported a number of recommendations developing from a meeting of that committee held the previous day (June 8). The first item submitted in his report was a petition for Section status for the Northwest Ohio Chapter (Grand Rapids) and the Oil Capital Chapter (Oklahoma). Coun-

To the Members of The Illuminating Engineering Society

I am inviting you and as many members of your organization as can possibly attend, to join with the other leaders in the lighting fraternity at the National Technical Conference of the Illuminating Engineering Society at Cleveland, the Lighting Center of the World, September 12-15.

The business sessions open Monday morning the 12th and in ten half-day conferences there will be authoritative papers by leaders of industry and science covering such topics as the Improvements in Light Sources for Better Lamp Performance, Better Lighting for the Home, Improved Calculations Methods, especially in regard to luminous ceilings, Outdoor Lighting Techniques, Visual Research, Architectural Lighting Advances, Store, Office, and Industrial Lighting reports and Street Lighting, plus the latest in Daylighting.

One highlight will be the evening presentation of the annual Progress Report. Then there will be the vivacious contests and awards for "My Most Interesting Lighting Job," and Tuesday morning's Residence Lighting Forum.

All this will be at the delightful Hotel Statler, so plan now to arrange your business or vacation schedule to take advantage of this Conference.

Nowhere else can you meet and discuss with so many industry leaders the key topics and problems of today and tomorrow. The ladies will also find this Conference delightfully worth while. Unique and special events are planned for them.

The changing character of so many vital features of lighting science and art, and the fluid condition of today's business emphasize the importance of keeping up-to-date on what is going on. You cannot afford to stay away.

Cordially yours,
DUNCAN M. JONES
President, I.E.S.

cil approved that Section charters be granted to both these qualifying groups.

Favorable action was also taken by Council on the recommendation to change the boundary of the Southwestern Region and Inter-Mountain Region, transferring the City of El Paso, Texas to the Inter-Mountain Region. It was noted that such transfer had been discussed and approved by all Sections, Chapters and Regions involved in it.

On recommendation of the Regional Vice-President for the South Pacific Coast Region, D. M. Finch, new by-laws were approved for the Northern California Section including a change in its name. This group will hereafter be named the Golden Gate Section.

A prospective Chapter is being developed in Halifax, N. S. Joe Thomas, incoming Regional Vice-President for the Canadian Region, reported to Council on the activities of this group and requested that authority be delegated to the July Executive Council to approve a charter for the prospective Chapter in Halifax, if its petition is ready by that time. Council so authorized.

Mr. Waterman reported that his committee had discussed ways and means of producing a Membership Roster for I.E.S., including participation by the Sections and Chapters in the compilation of local membership lists.

Among a number of other matters discussed at the Regional Activities Committee meeting, as reported by Mr. Waterman, was local participation in I.E.S. 50th Anniversary celebration. The Regional Vice-President feels the anniversary is a good opportunity for service on the local level, and would welcome specific ideas. Some of these, he indicated, might be meetings to honor old timers, past-chairmen, stressing past contributions, etc.

Glenn Park discussed the recent division of the Southern Region in which six of the twelve Sections and Chapters will operate under an Assistant Regional Vice-President. He recommended the appointment of George Morris of Birmingham, Ala., as Assistant to the Regional Vice-President of the Southern Region; Mr. Morris was so appointed.

Advance Planning

Professor E. M. Strong, Chairman of the Advance Planning Committee, submitted to Council the recommendation of his committee with regard to three matters of policy. Their Recommendation No. 1 was in regard to membership grades and requirements including the possibility of establishing a new grade (Senior Member) and statements on the qualifications of Member grade and Associate Member grade. The Advance Planning Committee's Recommendation No. 1 also included suggestions with regard to dues. Council's action on this recommendation referred the matter of membership grades and requirements to the Committee on Constitution and By-Laws for study and specific recommendation, to be submitted to Council in October. A further study on dues was assigned to a special Task Committee to be appointed later, made up of members of the Finance Committee, Membership Committee, Sustaining Membership Committee and other interested groups, with the chairman to be member of none.

Recommendation No. 2 of the Advance Planning Committee covered a new policy of the Society in regard to the publication of Transactions. "Transactions" were defined to include the following:

1. Any Recommended Practice of the Society.
2. Any Technical Committee Report which has been accepted and approved by Council for publication in full or in part.
3. Any papers accepted for presentation at the National Technical Conference.
4. The General Secretary's Report.
5. Actions of Council affecting the procedure and policy of the Society.

Recommendation No. 3 had to do with committee structure. Several details of this Recommendation were assigned to the Committee on Procedures and Policy for study and recommendation, but Council approved forthwith the recommendation that all committee chairmen be instructed to review their list of subcommittees and roster of personnel with the purpose of retaining only those subcommittees which are currently necessary and active. This also would restrict the size of each committee and subcommittee to the number actually needed.

Recommendation No. 4, which was approved by Council, eliminated the I.E.S. Research Planning Committee.

Technical Committee Reports

Several reports were presented to Council for approval. The report of the Committee on Lighting of Central Station Properties — Outdoor Areas, presented by William Lowell and detailed by L. G. Parks, Chairman of the Subcommittee preparing it, was accepted for letter ballot. Also accepted for letter ballot was the report "Television, Lighting for Production." A resolution of the Committee on Lighting Design Practice, submitted by John Neidhard, was approved by Council. Their resolution drew up a policy regarding the Society's system of room indices. Council recommended that their resolution be called to the attention of Sustaining Members, possibly via a letter from the Technical Director, and/or published in Illuminating Engineering.

John J. Neidhart, Chairman of the Office Lighting Committee, submitted to Council a revised "Recommended Practice of Office Lighting," details of which had been discussed, since last June, with the School Lighting Committee at Council's previous suggestion. Details of this report came in for considerable discussion before it was accepted for letter ballot, by a majority vote and a show of hands.

Council asked for acceptance for letter ballot a report of the Joint Committee of I.E.S. and American Society of Heating and Ventilating Engineers.

A report of the Lighting Service Committee (L. E. Tayler, Chairman) was submitted covering details and changes in the rules of the contest for "My Most Interesting Lighting Job." Council approved their recommendations, which in general continue the contest for another year, continue the present name of the contest, and change some of the rules of the contest, notably in connection with prior publication. The new rules will not disqualify an entry which has been published prior to its presentation at the contest.

Joint I.E.S.-U.S.P.H.S. Report

A report prepared by the Joint Committee I.E.S. - United States Public Health Service was presented by Kirk Reid and Messrs. Clayton and Doyle of the USPHS who were present at Council. The report was accepted by Council for study by the Technical Director and interested committees for editing and correcting technologically, and to the Publications Committee for study as to cost and possible publication and distribution. The report was referred back to the Joint Committee (J. F. Parsons, Chairman) for completion, to be submitted, together with report from the Publications Committee and the Technical Director at the October Council meeting.

Eleven New Fellows

Favorable action of letter ballots was reported on the election of eleven Fellows, on recommendation of the Board of Fellows. Complete details with pictures on these newly honored members of I.E.S. will be included in a forthcoming issue of Illuminating Engineering. Council's present action elected the following:

C. L. Amick	C. L. Cottrell
L. E. Barbrow	C. D. Gibson
A. C. Barr	Carter Lewis
B. S. Benson, Jr.	W. A. Pennow
A. H. Clarke	Mary E. Webber

C. E. Weitz

Before adjourning, Council set the date of their next meeting for October 13, 1955 in New York City.

At the Pacific Northwest Regional Conference: l. to r., R. G. Scott, Chairman of the Conference; President Duncan M. Jones, and Regional Vice-President Blair Plowman.

British Columbia Resort—Site for Pacific Northwest Regional Conference

When a Conference combines a resort area with a really distinguished technical program, it's hard to say which sets its "flavor"—which of the two entirely different phases might be emphasized in its report. The Pacific Northwest Regional Conference at a famous Canadian Rocky Mountain Spa, poses such a problem. On the one hand, its 139 delegates luxuriated midst the snow-capped mountain scenery of British Columbia, sapphire blue pools and lakes, blazing fires in huge native-stone fireplaces, dress-up occasions every night. At packed sessions during the day, however, they heard very top-level symposiums, "summit" speakers. Site of the meeting was Harrison Hot Springs, B. C., April 24-27, 1955.

For Fun

Threaded through the high-jinks was a theme, symbol of which was huge foot-prints, from a Sasquatch Indian legend of supermen, who, natch, carried off beautiful maidens (which legends modern maidens have been reading wistfully for ages now). These foot-prints appeared everywhere—as name tags on lapels, as tickets, and in giant size on the floor, leading the delegates to the session door. Every afternoon at four, they led all present, delegates and ladies as well, to the lounge for tea. This gracious custom couldn't have a better setting than the Harrison Hot Springs Hotel.

The social program did not include a dinner-dance. Instead, a cocktail party was held every evening before dinner in the glass-sided Copper Room of this fabulous place, in view of the purple mountain majesties. Private parties, and even an impromptu square dance, filled the evening hours. The objective of the lighting engineer who specified centered ceiling downlights in the hotel's suites was discovered by "fizz-fuzz" players at after-dinner parties. Its high-intensity spot dead center in the middle of the floor (and nowhere else) highlighted perfectly the penny forfeits.

At a session Tuesday evening, Walter Potter (General Electric Lamp Division, Portland, Oregon) put on a show on "Recent Lighting Developments" which was so entertaining as well as informative, that the ladies came too.

Pictures should be available (but aren't) of the fun which went on just before this show. A very realistic-looking member of the Royal Canadian Mounted Police, trailed by an Indian girl with a bundle in her arms, interrupted Chairman R. G. Scott with a whispered announcement. The startled chairman called I.E.S. President Duncan M. Jones to the stage, while the Mountie glared sternly. The Indian girl eagerly thrust her bundle at Mr. Jones, who must have been relieved to find that his present was a water-proof Indian sweater, with moccasins for Mrs. Jones. Ernie Adams of Griffon Sales Ltd., played the Mountie, Mrs. Dwyer of near-by Aggisiz, the Indian maid. The gifts were with the best wishes of the Pacific Northwest Region.

Technical Program

The technical program stood on its own, as an attraction well worth the trip. Further, it was shared widely by the public through the press, radio and television. The *Journal of Commerce*, Vancouver weekly newspaper, devoted its entire April 26 issue to details of the conference, and viewers of CBUT Vancouver television station saw a re-enactment of Walt Potter's lighting demonstration, which was filmed for later additional showing in other major Canadian cities. The pace for papers presented

Comparing notes are Irving Smith, Past Regional V-P Walter Lind, Ralph Yates and J. H. Gilbreath.

John Ruffato, Inland Empire Chapter, receives attendance trophy from Blair Plowman, Regional V-P (right).

was comfortably varied, with panel format alternating with individual lectures, and "Interesting Job" contest entries interspersed. One panel of particular interest was a symposium on "Comfort," an excellently organized discussion of visual comfort which was defined as "lack of annoyance from anything in the environment" — color, glare, light enough, anything.

Several interesting departures in subject matter were other features of the program. The relationship of agriculture and illuminating engineering, for instance, was the subject of an extremely interesting paper by J. A. MacCarthy, Farm Supervisor. Multi-functional ceilings was another popular subject, by Ralph Yates of London, Ontario, and the relationship of glass to lighting, by A. R. Jaeger, of Corning, N. Y.

A novel device kept things on time, during the technical program. An actual traffic signal, controlled from the chairman's desk, was set up for every session. When the speaker commenced his talk a green light was flashed. When two minutes remained of the speaker's time, an amber light went on, and at the termination of the scheduled time, a red light flashed and a gong rang. At that point the speaker had it. The close schedule was important, of course, in a resort hotel where all meals are on a strict time schedule.

Complete details of the technical program were:

MONDAY MORNING

Chuck Fields, *Chairman.*

Bob Scott, *General Conference Chairman.*

Blair Plowman, *Regional Vice-President, Pacific Northwest Region.*

Duncan M. Jones, *President*

The Fluorescent Lamp — Past, Present and Future — Dr. E. W. Lowry, Sylvania Electric Products, Inc., Salem, Mass.

Office Lighting — M. Cabot, Day-Brite Lighting Inc., San Mateo, Calif.

My Most Interesting Lighting Job — Supplementary Lighting for a Business Street" — Kenneth Reid, Vancouver Island Chapter.

My Most Interesting Lighting Job — Lighting of a Sheet Metal Shop — John W. Adams, Inland Empire Chapter.

MONDAY AFTERNOON

Gordon Roper, *Chairman.*

Floodlighting of Structures — O. C. Westburg, Benjamin Electric Mfg. Co., San Francisco, Calif.

Lighting Maintenance — R. L. Oetting, General Electric Lighting Institute, Nela Park, Cleveland, Ohio.

My Most Interesting Lighting Job — Light Conditioning a Modern Office-Warehouse — W. J. Lind, British Columbia Section.

The Magic Lamp in Agriculture — J. MacCarthy, British Columbia Electric Co. Ltd.

My Most Interesting Lighting Job — A Controlled Visual Environment — Frank Reis, Oregon Section.

Harry Wharton of Corning Glass in Toronto seems to have found a Sasquatch leg fitting the footprints.

TUESDAY AFTERNOON AND EVENING

Marvin Prestwood, *Chairman.*

My Most Interesting Lighting Job — Lighting of Lynnwood School — B. T. Heinz, Puget Sound Section.

The Need for Visual Comfort — R. L. Oetting.

Effect of Light Sources on Visual Comfort — E. W. Beggs.

Use of Area Lighting Systems in Achieving Comfort — R. A. Yates.

Relationship of Glass to Comfortable Lighting — A. R. Jaeger.

Using Glare Factors to Specify Comfortable Lighting — M. Cabot.

VCI's for Working Eyes — R. L. Oetting.

Recent Lighting Developments—Walter Potter, General Electric Lamp Division, Portland, Ore.

WEDNESDAY MORNING

John Ruffatto, *Chairman.*

Designs in Glass — A. R. Jaeger, Corning Glass Works, Corning, N. Y.

Luminous Ceilings — R. A. Yates, Wakefield Lighting Limited, London, Ont.

Lighting in 3-D — Irving Smith, Curtis Lighting of Canada Limited, Toronto, Ont.

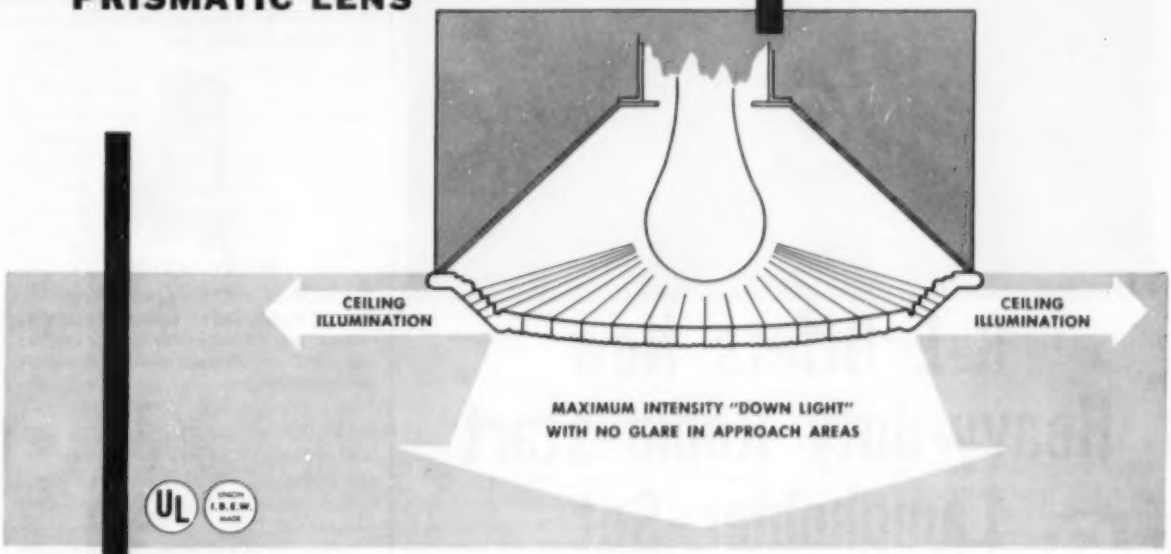
I.E.S. Executive Secretary Dex Hinckley with Past Regional V-P Ken Hollingsworth.

Vancouver Island contingent: Percy Fletcher (now of Vancouver), Ken Reid and Gordon Roper.

Pry-Lite STRATO-RAY

PRISMATIC LENS

the only recessed lighting fixture providing ceiling illumination!



Exclusive!
ALZAK*REFLECTOR

**Alcoa's amazing metallurgical discovery that provides the greatest reflection quality of any surface yet known!*

This new advance-design lens literally bends light rays upwards and across ceiling. At the same time, provides evenly distributed floor lighting with no glare in the approach areas.

Pry-lite Strato-Ray fixtures are available in 7 models... with trip latch or tamper-proof front, and to lamp from above or below... for all types of commercial and residential installation.

STRATO-RAY
MODEL 2230
Replaces 12 x 12 acoustical tile with or without overlap

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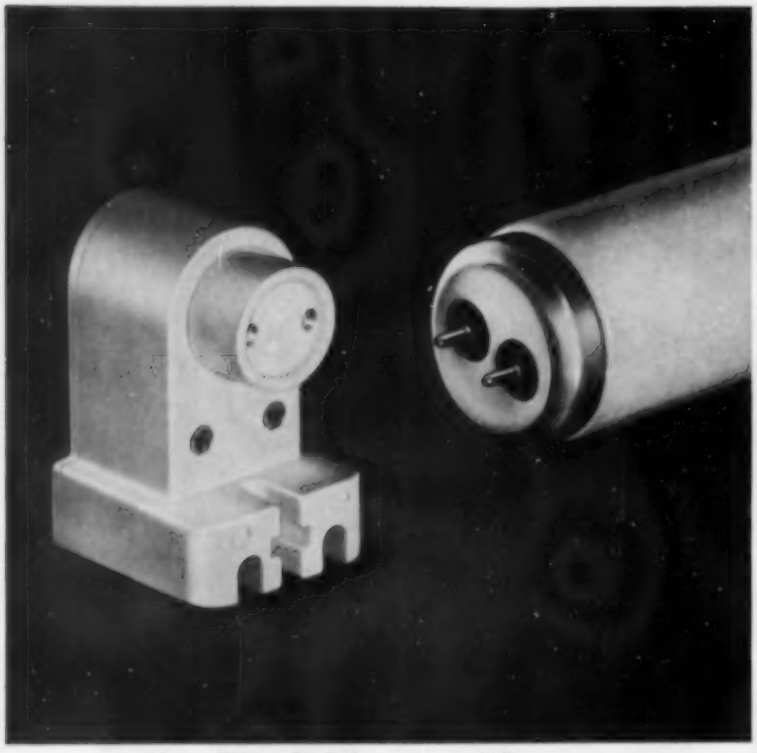


G-E Offers New Heavy-duty Rapid-start Lampholder Set

Built-in Telescopic Action Makes Insertion Easy Eliminates the Hazard of Falling Lamps

General Electric's Accessory Equipment Department offers a new heavy-duty bi-pin lampholder set designed to meet the growing demand for sturdy, easy-to-install lampholders. The lampholder set can be used for either rapid-start or switch-start lamps. It provides telescopic action and gives support for the full length of the lamp pins.

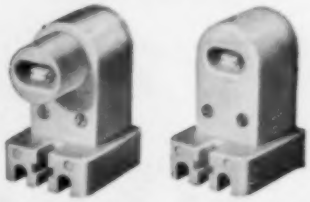
The new lampholders have spring-loaded contacts and the advantage of simple push-in lamp insertion. This design assures positive contact at all times and holds the lamp securely in place without need of special guards. The lampholders are listed by Underwriters' Laboratories, Inc., for use with all T-8 and T-12 bi-pin lamps. Outline dimensions are the same as General Electric's popular 502X63 and 502X64 slimline lampholders.

For complete information on these and other General Electric lampholders, write to Accessory Equipment Dept., General Electric Company, Bridgeport 2, Connecticut.

Progress Is Our Most Important Product

GENERAL ELECTRIC

OTHER G-E RAPID-START LAMPHOLDERS



Rapid-start telescopic type: for use with new G-E 96T12 high-output lamps. Interchangeable in mounting with slimline telescopic types . . . has the same outline dimensions as the new telescopic bi-pin lampholder set.

Medium bi-pin disconnect type: contains circuit-interrupting switch and 9-inch pigtail lead. For use in conjunction with rapid-start ballast disconnect lampholders.

Standard medium bi-pin type: may be used for rapid-start application with T-8 and T-12 lamps. Rotary-lock lamp insertion.

Rapid-start Turret* lampholder: spring-backed contact plates anchor lamps securely and eliminate safety guards. Available in two-lamp types on 3½" and 5" centers and in three-lamp type on 2½" centers. Built-in shunts eliminate splices.

*Registered Trade-mark General Electric Company

ACCESSORY EQUIPMENT DEPARTMENT

Manufacturers of wiring components for lighting • appliances and equipment power supply cords • wiring harnesses

Applications of Mercury Vapor Lighting — E. W. Beggs, Westinghouse Electric Corp., Bloomfield, N. J.
Blair Plowman — Contest Winners and Closing Session.

M.M.I.L.J.

The contest for "My Most Interesting Lighting Job" was presented in a somewhat different manner at the Pacific Northwest Conference. Instead of a complete session, the contest presentations were interspersed throughout the program for both days. Judging was done at the final session. Five judges: Matt Cabot, Day-Brite Lighting Western Sales Manager, A. R. Jaeger, Corning Glass Works, R. L. Oetting, General Electric Co., Cleveland, Irving Smith, Curtis, Toronto, and R. A. Yates, Wakefield, London, Ontario. Their judgments and entries:

FIRST PRIZE: W. J. Lind, British Columbia Section.

SECOND PRIZE: B. T. Heinz, Puget Sound Section.

THIRD PRIZE: John W. Adams (David Moses, proxy), Inland Empire Chapter. Kenneth Reid, Vancouver Island Chapter. Frank Reis, Oregon Section.

ATTENDANCE AWARD

The Pacific Northwest Region, like several others in I.E.S., has a much coveted award earned at each Regional Conference by the Section or Chapter having the highest attendance in relation to total membership and miles traveled. This is a handsome plaque, carried off this year by the Inland Empire Section. Attendance of 139 at the Conference was from every Section and Chapter within the Region, plus seven I.E.S. members from Alberta, and fourteen easterners.

CREDIT DUE

The following should receive congratulations of all concerned, for an exceptionally successful and enjoyable Regional Conference:

Blair E. Plowman ..... Regional V-P

British Columbia Section

Chairman ..... Tom Doherty
Secretary ..... Norman Kolbeins

Inland Empire Chapter

Chairman ..... John Ruffatto
Secretary ..... George Romans

Oregon Section

Chairman ..... Marvin Prestwood, Jr.
Secretary ..... Don Pearson

Vancouver Island Chapter

Chairman ..... Gordon Roper
Secretary ..... Walter Beek

Conference Committees

Gen'l Conference Chairman ..... Bob Scott
Program and Papers ..... Reg Racine
Finance ..... Doug Gordon
Registration, Hotel and Properties ..... Ernie Thompson
Transportation ..... Eric Ackland
Publicity ..... Brett Manlove
Members-at-Large ..... Walter Lind, Tom Doherty

President D. M. Jones, at microphone, thanks the Mayor of Montreal Jean Drapeau for the city's hospitality to I.E.S. Conference. Monsieur Drapeau is second from left (with glasses). He officiated at brilliant civic reception for I.E.S. held in the Hall of Honour in the City Hall.

Twelfth Canadian Regional Conference
Civic Reception a Feature

The City of Montreal, frequently referred to as the "Paris of the Western Hemisphere" was literally host to the I.E.S. Canadian Regional Conference held there May 11, 12 and 13. One of the highlights of the meeting was a Civic Reception for I.E.S. delegates and their wives, at which Mayor Jean Drapeau and his Municipal Council were the hosts. Held at the Hall of Honour of Montreal, the Reception featured a cocktail party, and a most elaborate and excellent buffet supper, attended by the entire registration of the conference. Mayor Drapeau's speech of greeting was acknowledged by I.E.S. President Duncan M. Jones, whose home base is Montreal, and by Regional Vice-President Milton Hastings.

Headquarters for the conference itself was the Sheraton-Mount Royal Hotel in Montreal. Here an almost record attendance of 175 heard some 12 papers in the two days of technical sessions. Quite in line with the "Convention-style" organization of the Canadian meeting, was distribution of preprints of all papers presented, and well organized discussion and rebuttal at each session. The stature of the meeting was well recognized by the extent of its press coverage, also. An official press room was part of the conference accommodations, and was frequented daily by newspaper and trade press representatives. Regular press releases were sent out to all Montreal and Toronto dailies and selected radio stations, by the group of active I.E.S. members, who are also professional members of the fourth estate. This program was under the direction of Doug Mason of Canadian Industries, Inc., David Kundsen, editor of *Electrical News and Engineering*, Rene Dorion, editor of *Le Digeste des Maitre Electriciens*, and Miss Lois Doucette.

A delegation of I.E.S. members from New England traveled to Canada for the meeting, which courtesy was later returned by a group of Canadians planning to go to Lake George, N. Y., at the Northeastern Regional Conference held there June 10-12. In all, 20 Americans were registered.

M.M.I.L.J.

In the Lighting Contest, which is hotly contended in Canada, there were four entries. First place was won by Harry R. Nellis, of Toronto Section, with a large modern church. Leslie A. Mackie, of Maritime Chapter won second prize, with an installation in a small chapel, presented for him by George C. Robinson of Curtis Lighting of Canada, St. Johns, N. B. Third prize was a tie between George Watters (Lighting an Ice Palace) and Roy Eshelby (Gas Station Lighting). Mr. Nellis, of course, will represent the Region at the National contest in Cleveland next September.

Lifetime lighting for modern hospitals

Hospital administrators—realizing that they have to "live with" their lighting installations for 20 years and more—are taking a longer look at the fixtures they buy. As a result, more and more of them specify Day-Brite.

Day-Brite lifetime installations in modern hospitals range from floor to ceiling—reception halls, waiting rooms, administrative offices, nurses' stations, kitchens, cafeterias, laundries, bedrooms, libraries, corridors.

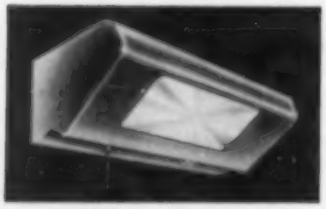
CALL YOUR DAY-BRITE REPRESENTATIVE—he knows modern hospital lighting . . . SEE! EXAMINE! COMPARE! Make a point-by-point check of competitive fixtures—then rely on your own judgment!

Day-Brite recessed Duo-Frame units are ideal for comfortable, attractively lighted waiting rooms.

Day-Brite Plexoline® light nurses' training classroom—create a high level of illumination without glare.

Day-Brite Glass-enclosed Troffers in administrative offices create cheerful work quarters for personnel by providing effective over-all light.

Day-Brite Exit Signs mark exits, direct corridor traffic. Equipped with two sockets for continuous operation in case one lamp fails.



Day-Brite Bed Lamps provide comfort and convenience for the patient—direct light for reading, indirect light for general use.

"DECIDEDLY BETTER"
DAY-BRITE
Lighting Fixtures

Day-Brite Lighting, Inc., 5432 Bulwer Ave., St. Louis 7, Mo. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

5475

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

At the civic reception at the Canadian Regional Conference are Mayor Jean Drapeau, and Regional Vice-President M. B. Hastings and Mrs. Hastings.

Meet the Press: Left to right, Rene Dorion, Editor, *Le Digeste des Maitre Electriciens;* Miss Lois Doucette, Publicity Committee; Doug Mason, Chairman, Publicity and Information Committee; Dave Knudson, Editor, *Electrical News and Engineering.*

Social Program

In addition to the Civic Reception, the delegates at the Canadian Conference relaxed ensemble, at a formal banquet and dance which wound up the conference. Section and Chapter participation in the entertainment is traditional at their Regional parties. Typical I.E.S. spirit (and obviously considerable rehearsing) was evident in the skits presented by the Montreal Section, scenario by M. Remy. Quebec Chapter entertainment was led by Denis Theriault; Toronto Section had a parody on "Davey Crockett" which was a musical tribute to President Jones. Climaxing the festivities, the Region presented to Mr. Jones, a beautiful silver cigar-cigarette box, and to Mrs. Jones a broach.

The ladies joined all this, of course. In addition, however, they had their own special program. On their agenda were a visit to Henry Birks' famous Canadian silver manufacturing shops, where they were shown various steps in production of flat-wear, services, etc. A coffee session interspersed with a talk by Douglas Walkington of Canadian Industries, who drew on his long and broad experience to tell them about plastics, fabrics, dyes, color harmony, etc. A luncheon at Desjardins Seafood Restaurant.

Technical Program

Full text of all papers was available to each delegate for the following program:

Thursday, May 12

R. S. Tate, *Chairman* (Montreal)

Address of Welcome and Introduction of I.E.S. President — M. B. Hastings, Canadian Regional Vice-President.

President's Remarks — Duncan M. Jones, President, Illuminating Engineering Society.

Morning Session

E. M. Haacke, *Chairman* (Montreal)

My Most Interesting Lighting Job Competition, Canadian Regional Finals.

Luncheon

M. K. Strang, *Chairman* (Toronto)

Speaker: Duncan M. Jones
"The President's Message."

Afternoon Session

L. Dupuis, *Chairman* (Ottawa)

School Lighting Applications & Economics
Speaker: J. M. Chorlton, Deputy Superintendent of Maintenance, Toronto Board of Education, Toronto, Ont.
Discussion of paper: "School Lighting Applications & Economics" led by:
D. C. Borden, Representing Quebec Federation of Home & School Associations.
J. E. Tansey, B. Opt. Manager, Optical Dept., The T. Eaton Co. Ltd., Montreal.
F. J. Nobbs, Architect, Montreal.
A. H. Mendel, Consulting Engineer, Mendel, Brasloff, Lassman & Sidler, Montreal.
J. G. Hannan, Maintenance Officer, Protestant School Board of Greater Montreal.

Friday, May 13

Morning Session

N. W. Bethune, *Chairman* (Hamilton)

Cold Cathode Light Sources:
Speaker: A. A. Byer, President, Cold Cathode Lighting Corporation, New York, N. Y.
Practical Factors Affecting the Choice of Light Sources for Various Applications:
Speaker: M. N. Waterman, Junior Vice-President, I.E.S., Westinghouse Electric Corp., Bloomfield, N. J.
Latest Development in Fluorescent Light Sources:
Speaker: C. A. Amick, Application Engineer, General Electric Company, Cleveland, Ohio.
Electric Discharge Lamp Auxiliaries:
Speaker: M. Robinson, Engineer, Jefferson Electric Company, Bellwood, Ill.
A Comparison Between Incandescent, Mercury and Fluorescent Light Sources for High Bay Industrial Lighting:
Speaker: R. R. Wylie, Illuminating Engineer, National Sales Department, Sylvania Electric Products Inc., New York, N. Y.
Discussion.

Luncheon

J. D. Theriault, *Chairman* (Quebec)

Speaker: George J. Taylor, Treasurer, I.E.S. Day-Brite Lighting Inc., New York, N. Y.

Afternoon Session

E. L. MacElmon (Maritime)
James Senez (Winnipeg)
Co-Chairmen

Our Streets Can Be Beautiful — and Useful:
Speaker: Kirk M. Reid, General Secretary, I.E.S., General Electric Co., Cleveland, Ohio.
Improved Street Lighting in Toronto:
Speaker: J. Alexander, Engineer, Toronto Hydro-Electric System, Toronto, Ont.
Underpass Lighting:
Speaker: A. Leduc, Technical Section Engineer, Mechanical and Electrical Section, City of Montreal.
Lighting of an Open Air Theatre:
Speaker: J. Palikowski, Engineer, Mechanical and Electrical Section, City of Montreal.
Discussion.

Evening

President's Reception, Banquet.
Chairman: M. B. Hastings, Canadian Regional Vice-President.
Dancing.

Credit Due

Special credit should be forthcoming to many members of the several Sections and Chapters of the Candian Region, who pitched in with weeks of work. All of these hard workers were under the organization of the following:

Conference Committee

M. B. Hastings — Canadian Regional Vice President
R. S. Tate — Conference Chairman
R. K. Owen — Vice-Chairman
C. E. Mertens — Secretary
V. Stubbings — Treasurer

CANADIAN REGIONAL COMMITTEE CHAIRMEN

Papers and Program	R. A. Esbelby
Finance	V. Stubbings
Entertainment	D. Brooks
Attendance	A. H. Johnson
Publicity	D. Mason
Registration	B. C. Doucet
Hotel	J. P. Cristel
Reception and Transportation	J. G. Hannan
Ladies	Mrs. B. C. Doucet

Reports on the Midwestern Regional Conference, held in Chicago, and the Northeastern Regional Conference, held at Lake George, N. Y., will appear in the August issue of I. E.

Eastern Pennsylvania Section — Host To East Central Regional Conference

The East Central Regional Conference of I.E.S. was held May 19-20 at the Hotel Abraham Lincoln in Reading, Pa., with the Eastern Pennsylvania Section as host. Technical sessions, entertainment with a dash of Pennsylvania Dutch flavor, and the contest for My Most Interesting Lighting Job kept delegates to the Conference interested, instructed and amused.

The Conference was called to order, after registration on Thursday morning, by the Honorary Chairman, J. M. Stedman, of Pennsylvania Power and Light Co., Allentown, and was welcomed by W. H. McElwain, Vice-President of the Metropolitan Edison Company. The President's Luncheon that noon was attended by two Past-Presidents of the Society, E. M. Strong and S. G. Hibben; General Secretary Kirk M. Reid as well as the guest of honor, President Jones.

MMILJ CONTEST

One of the highlights of the meeting was the contest for My Most Interesting Lighting Job — presentations on Friday morning, awards Friday afternoon. The East Central Region is an old hand at this contest, originating the competition at their 1949 Regional Conference. This year's entries included four outstanding installations, the first prize winner being the lighting job for the Baltimore Memorial Stadium, home of the now major-league Orioles. H. M. White, of Baltimore Power and Light was the engineer whose job permitted the schedule of our National Pastime to continue without lighting rhubarbs.

Other entries were: an open-front variety food market by Josef Tama, West Penn Power and Light (Pittsburgh Section); Grossman's store by Harry Weidman, Pennsylvania Power and Light (Eastern Pennsylvania Section); relighting a Free Library by G. W. Wagner, Philadelphia Electric Co. (Philadelphia Section).

ENTERTAINMENT

The highlight of any conference is, of course, the Banquet, and at the East Central Regional about 170 representatives from all the region's Sections and Chapters attended. Entertainment was furnished by a group of Pennsylvania Dutch teen-agers performing traditional German dances of the locality, which their fore-fathers had brought with them from Bavaria.

President Jones and Regional Vice-President C. J. Berry were both presented with "Golden Hour" electric clocks, as gifts from the Region.

TECHNICAL PROGRAM

Thursday Morning

Registration.
Call to Order — Honorary Chairman J. M. Stedman, Pennsylvania Power and Light Co., Allentown.
Address of Welcome — W. H. McElwain, Vice President, Metropolitan Edison Co., Reading.
Chairman — Westerman McCouch, Philadelphia Section.
The Role of Plastics in Lighting — Dr. O. L. Pierson, Rohm & Haas Co., Philadelphia.
President's Luncheon — Toastmaster, Regional Vice-President C. J. Berry.
Address, Duncan M. Jones, President, I.E.S.

Thursday Afternoon

Chairman — Hugh S. James, Pittsburgh Section.
Leave hotel by bus for Auditorium of Metropolitan Edison Co.
Future Bright with Light for Industry — E. W. Beggs, Westinghouse Electric Corp., Bloomfield, N. J.
Lighting for Stimulation of Plant Growth — Jos Ditchman, General Electric Co., Cleveland.
Introduction to Inspection Tour of Metropolitan Edison Offices — Ben Barr and Frank Heins.
Tour of Office, then back to hotel.

Thursday Evening

Chairman — Paul A. Kinsey, Eastern Pennsylvania Section.
Banquet — Speaker, Rev. Harry Richwine.

Friday Morning

Chairman — George F. Walter, Maryland Section.
My Most Interesting Lighting Job Contest.
Panel Discussion.

Friday Afternoon

Chairman — Jack Downing, Virginia Chapter.
Developments in Panelescent Lighting — R. G. Slauer, Sylvania Electric Products, Inc., Salem, Mass.
Developments and Trends in Fixture Design — G. R. Baumgartner, General Electric Co., Cleveland.
The Future of Lighting — S. G. Hibben, Engineering Consultant, Montclair, N. J.
Presentation of Awards — MMILJ Contest — C. J. Berry, Regional Vice-President.

CONFERENCE EXECUTIVE COMMITTEE

P. A. Kinsey	General Conf. Chairman
Westerman McCouch	Vice-Chairman
Carl J. Long	Vice-Chairman
George F. Walter	Vice-Chairman
Dorothy Nickerson	Vice-Chairman
Jack Downing	Vice-Chairman
C. A. Oerkvitz	Secretary-Treasurer
F. M. Gochenaur	Program

I.E.S. Officers Elected For Year 1955-1956

At a meeting of the I.E.S. Council held June 9, 1955, the report of the Committee of Tellers was presented, giving the results of the recent election of officers for the coming year, beginning October 1, 1955. The following have been elected to the offices indicated.

GENERAL OFFICERS

President—R. F. Hartenstein, Ohio Edison Co., Akron, Ohio.
Vice-President — Kirk M. Reid, General Electric Co., Cleveland, Ohio.
General Secretary — George J. Taylor, Day-Brite Lighting, Inc., New York, N. Y.
Treasurer — Joseph S. Schuchert, Duquesne Light Co., Pittsburgh, Pa.
Directors (Until 1958) — G. F. Dean, Toronto Hydro-Electric System, Toronto, Ont.; Brooks Chassaing, The Art Metals Company, St. Louis, Mo.
Regional Vice Presidents — Canadian Region, Joseph Thomas, Canadian General Electric Co., Montreal, Que.; *East Central Region*, Nelson C. Warner, Westinghouse Electric Corp., Pittsburgh, Pa.; *Inter-Mountain Region*, J. D. Whitnell, Arizona Public Service Co., Phoenix, Ariz.; *Southern Region*, J. Dixon Mitchell, Westinghouse Electric Corp., Chamblee, Ga.; *Southwestern Region*, John O. Felton, Jr., Sylvania Electric Products Inc., Dallas, Texas.

ARIZONA SECTION

Chairman—Bevan Jones, Jr., Arizona Public Service Co., Phoenix, Ariz.
Vice-Chairman — John F. Gohring, J. E. Redmond Supply Co., Phoenix, Ariz.

(*Continued on page* 17A)

KOPP *Engineered* Glass

Serves a wide variety of exacting applications

Over 50 years of good, practical experience, a staff of trained engineers, a modernly equipped laboratory and skilled, conscientious shopmen give Kopp the ability to supply you with the most dependable technical glassware available.

Whether it be a trim, individually designed "bullseye," a sturdy sight glass or a technically perfect lens for traffic or railroad signaling, Kopp can guarantee to meet your specifications to the letter. Every Kopp lens, color filter or roundel, in any size or shape, is engineered with precision and manufactured with craftsmanship. The illustrations on this page are but a few of thousands made by Kopp.

Let us submit ideas, designs and prices for your consideration.

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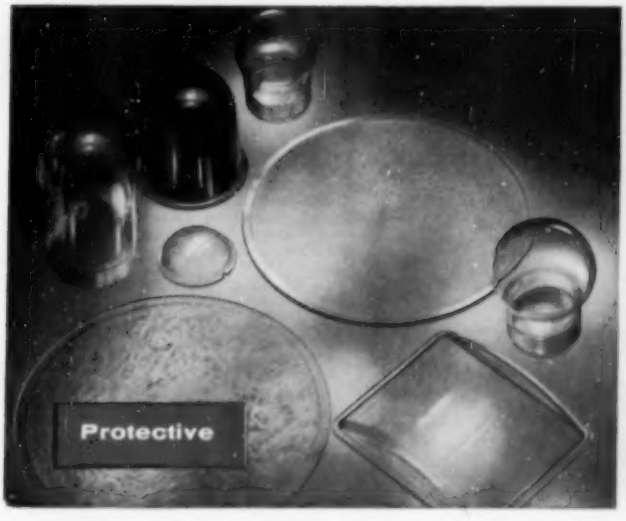
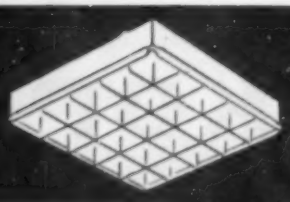
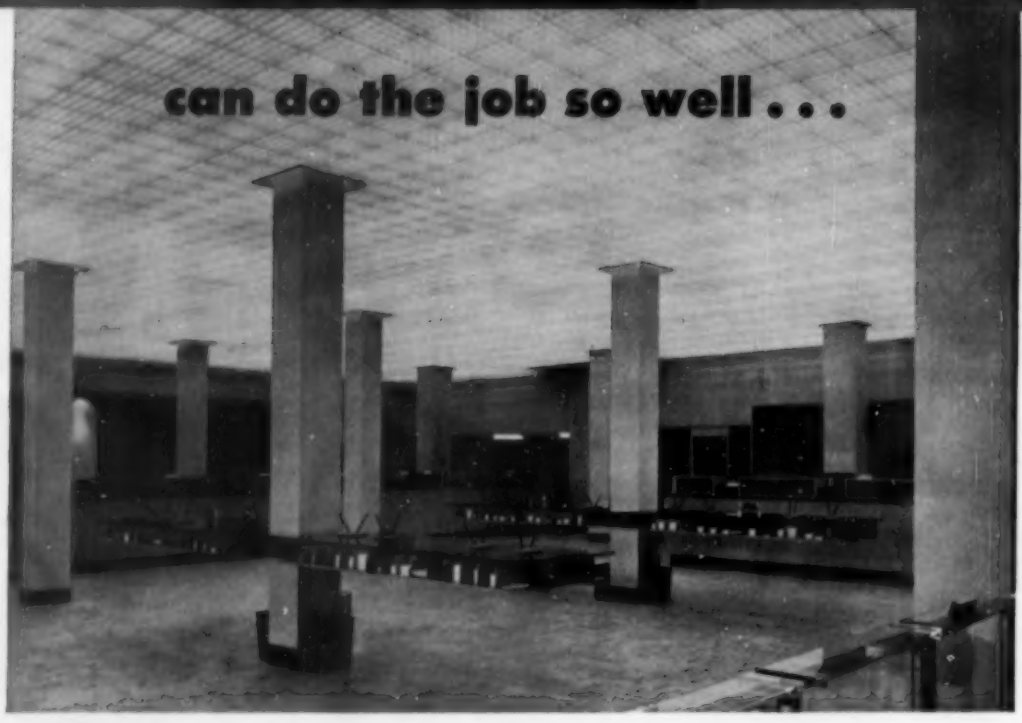


Only - Luve·tile



can do the job so well . . .



When it comes to Low brightness, large area light sources . . .

Another striking example of how LUVE-TILE provides the utmost in illuminated ceilings is shown in these photos of the Industrial National Bank of Detroit, Michigan.

LUVE-TILE is easy to maintain—dirt collection is much less rapid than with other types. . . and it will not hold insects and other small matter. Because LUVE-TILE is hinged, servicing of fixtures is easy. LUVE-TILE is also rigid to handle, light in weight and easy to remove and wash.

LUVE-TILE may be assembled to suit any room and custom-made work is never necessary. No unsightly horizontal bars or rosettes are used for support. Since LUVE-TILE comes in 4 shades unlimited colour combinations are possible.

Sprinklers and air ducts are concealed and wiring and other work may be simply surface mounted. Also low cost acoustic material may be sprayed on the cavity above the tile for sound proofing. LUVE-TILE is practical and economical to use in any area, right down to a few square feet. It is also widely used in display for special effects.

These Firms Were Concerned with the Industrial National Bank Building

Architect and Engineer	Louis C. Redstone 10811 Puritan, Detroit
Contractor	Turner Engineering Company 470 Brainard, Detroit
Wholesaler	Michigan Chandelier, Company

Write for free LUVE-TILE Catalogues sections Nos. 8 and 8A.

J. A. WILSON LIGHTING & DISPLAY INC.

632 MAIN STREET, BUFFALO 2, N.Y. PHONE MOhawk 5596

IN CANADA 280 LAKESHORE ROAD TORONTO, ONTARIO

(Continued from page 14A)

Secretary — James R. Williams, Arizona Public Service Co., Phoenix, Ariz.
Board of Managers—A. W. Brown, D. M. Demaree, Glenn Kiger, P. G. Young.

BRITISH COLUMBIA SECTION

Chairman—J. H. Gilbreath, Holophane Co. Inc., Vancouver, B. C.
Vice-Chairman—D. S. Gordon, British Columbia Electric Rwy. Co. Ltd., Vancouver, B. C.
Secretary-Treasurer—E. N. Kolbeins, Associated Consulting Engineers, Vancouver, B. C.
Board of Managers — P. A. Donelly, Miss J. L. MacKenzie, L. S. Smith, E. W. Thompson.

CAPITAL SECTION

Chairman — Benjamin Goodman, National Electric Wholesalers, Washington, D. C.
Vice-Chairman—Harold V. Oerting, Potomac Electric Power Co., Washington, D. C.
Secretary-Treasurer — Samuel W. Charlesworth, General Electric Supply Co., Washington, D. C.
Board of Managers — G. Allison Long, Jr., N. George Maloomian, Dorothy Nickerson, Paul Norris.

CENTRAL NEW YORK SECTION

Chairman — William McNulty, Jr., Graybar Electric Co., Syracuse, N. Y.
Vice-Chairman — E. L. Moyer, Malcolm B. and Edward L. Moyer, Syracuse, N. Y.
Secretary-Treasurer — John J. McVey, Niagara Mohawk Power Corp., Syracuse, N. Y.
Board of Managers — R. O. Clark, R. H. Goodman, J. P. Hozie, W. A. Lampinen.

CHICAGO SECTION

Chairman—Robert J. Diefenthaler, General Electric Co., Chicago, Ill.
Vice-Chairman—Eric H. Church, Benjamin Electric Mfg. Co., Des Plaines, Ill.
Secretary—Willis F. Carson, Public Service Co. of Northern Illinois, Maywood, Ill.
Board of Managers—Carl F. Jensen, Arthur P. Larson, Joseph A. Schneller, Gerald M. Marks.

CLEVELAND SECTION

Chairman—G. K. Warner, Greene & Warner, Cleveland, Ohio.
Secretary—J. G. Mitchell, Grant Electric Company, Cleveland, Ohio.
Board of Managers—Theodore Ake, C. J. Allen, E. I. Creed, J. J. Neidhart, R. G. Zimmerman.

CONNECTICUT SECTION

Chairman—Henry S. Kelly, 282 York St., New Haven, Conn.
Vice-Chairman—Merritt Horner, 815 Chestnut Hill Rd., Glastonbury, Conn.
Secretary — Robert D. Babcock, General Electric Co., New Haven, Conn.
Board of Managers—W. P. Carpenter, Dean Farnsworth, R. O. Mills, L. A. Senofonte.

EASTERN PENNSYLVANIA SECTION

Chairman—Ford M. Gochenauer, Pennsylvania Power & Light Co., Lancaster, Pa.
Vice-Chairman — C. A. Oerkvits, Westinghouse Electric Corp., Allentown, Pa.
Secretary-Treasurer—E. W. Kelsey, Pennsylvania Power & Light Co., Harrisburg, Pa.
Board of Managers—J. P. Fritz, P. A. Kinsey, G. E. Parks, R. J. Pretzman.

FLORIDA SECTION

Chairman—Joseph A. Savarese, Jr., Tampa Electric Co., Tampa, Fla.
Vice-Chairman—Barney P. Best, Florida Power Co., Clearwater, Fla.
Secretary—Ray L. Sirmons, Florida Power Corp., Clearwater, Fla.
Board of Managers—R. C. Bedford, D. B. Clarke, Frank Moss, Ray Schad.

GEORGIA SECTION

Chairman — Judd Lough, Holophane Co. Inc., Atlanta, Ga.
Vice-Chairman — O. V. Scott, O. V. Scott Electric Co., Atlanta, Ga.

LIGHTING CALENDAR

Society Events

September 12-16, 1955 — Illuminating Engineering Society, National Technical Conference, Hotel Statler, Cleveland, Ohio.

Industry Events

July 12-14, 1955 — Western Plant Maintenance and Engineering Show, Pan Pacific Auditorium, Los Angeles, Calif.

August 15-19, 1955 — American Institute of Electrical Engineers, Pacific General Meeting, Butte, Montana.

September 12-14, 1955—American Institute of Electrical Engineers, Electrical Conference of the Petroleum Industry, Shamrock Hotel, Houston, Texas.

September 25-28, 1955 — National Association of Electrical Distributors, Annual Convention, Pacific Zone, Empress Hotel, Victoria, B. C.

September 27-29, 1955—Electrical Progress Show, Convention Hall, Philadelphia, Pa.

October 1, 1955 (Tentative) — Institute of Traffic Engineers, 26th Annual Meeting, Pittsburgh, Pa.

October 3-5, 1955—National Electronics Conference, Hotel Sherman, Chicago, Ill.

October 3-7, 1955—Society of Motion Picture and Television Engineers, 78th Semi-annual Convention, Lake Placid Club, Essex County, N. Y.

October 3-7, 1955 — American Institute of Electrical Engineers (Fall General Meeting), Morrison Hotel, Chicago, Ill.

October 5-7, 1955 — Canadian Electrical Manufacturers Association (11th Annual Meeting), Sheraton-Brock Hotel, Niagara Falls, Ontario, Canada.

October 11-14, 1955 — National Electrical Industries Show, 69th Regiment Armory, New York, N. Y.

October 17-21, 1955 — National Safety Council, 43rd National Safety Congress & Exposition, Chicago, Ill.

October 24-26, 1955 — 37th Annual Meeting and Sixth National Conference on Standards, American Standards Association, Washington, D. C.

October 30, 1955—Week of—National Electrical Contractors Association, Waldorf-Astoria, New York, N. Y.

November 1-3, 1955 — Fifth Industrial Electric Exposition, Hotel Wm. Penn, Pittsburgh, Pa.

November 2-5, 1955 — National Electrical Contractors Association, Annual Convention, Waldorf-Astoria Hotel, New York, N. Y.

November 14-18, 1955 — National Electrical Manufacturers Association, Annual Meeting, Traymore Hotel, Atlantic City, N. J.

November 14-18, 1955 — Chicago Exposition & Power and Mechanical Engineers ASME, Chicago Coliseum, Chicago, Ill.

November 28 - December 1, 1955 — Ninth Air Conditioning & Refrigeration Exposition, Auditorium, Atlantic City, N. J.

January 30 - February 3, 1956 — American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York, N. Y.

February 26-29, 1956 — National Electric Sign Association, Annual Convention, Jefferson Hotel, St. Louis, Mo.

March 12-16, 1956 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

PROGRESS in street lighting is the subject discussed as (left to right) **Harold Quinton, President of Southern California Edison Co.; Jack Rohring of I.E.S. and Sheriff Eugene Biscailuz of Los Angeles County, compare a replica of the original Thomas Edison lamp with the modern 20,000-lumen mercury vapor street light. The meeting was held in the sheriff's office.**

(Continued from page 17A)

Secretary—T. W. Haslam, Georgia Power Co., Atlanta, Ga.
Board of Managers—S. J. Andre, P. F. Harrison, J. D. Poage, F. G. Sessoms.

Heart of America Section

Chairman—Carl W. Thorsell, 1195 E. 77th St., Kansas City, Mo.
Secretary—Francis E. Miles, Francis E. Miles Electric Co., Kansas City, Mo.
Board of Managers—G. G. Harper, Jr., M. A. Havenhill, B. F. Kindell, J. L. Krall, F. P. O'Conner.

Indiana Section

Chairman—Edward M. Chellew, Indianapolis Power & Light Co., Indianapolis, Ind.
Vice-Chairman—A. S. Coffin, Jr., Public Service Co. of Indiana Inc., Plainfield, Ind.
Secretary—Robert L. Peloquin, Westinghouse Electric Corp., Indianapolis, Ind.
Board of Managers—R. E. Crockett, J. C. Darrow, S. E. Jenkins, Roger Lawton.

Iowa Section

Chairman—Leroy J. Widigen, Iowa-Illinois Gas & Electric Co., Davenport, Ia.
Secretary—Gale L. Williams, Iowa Public Service Co., Waterloo, Iowa.
Board of Managers—M. H. Galbraith, R. P. Goodwater, R. E. Hixson, R. C. Holcombe, H. W. Johnson.

Maryland Section

Chairman—E. B. White, III, McNeill & Baldwin, Baltimore, Md.
Vice-Chairman—J. Clifford Riley, Graybar Electric Co., Baltimore, Md.
Secretary-Treasurer—C. E. Sparrow, Jr., Westinghouse Electric Corp., Baltimore, Md.
Board of Managers—C. J. Berry, L. W. Morgan, G. F. Walter, G. W. Younglove.

Michigan Section

Chairman—Edward L. Fairchild, Wayne University, Detroit, Mich.
Secretary—Earl R. Demoney, Consumers Power Company, Saginaw, Mich.
Board of Managers—James F. Finn, L. H. Gussow, A. H. Henson, E. A. Keidel, H. B. Robbins.

Milwaukee Section

Chairman—Beverly R. Bunn, Westinghouse Electric Supply Co., Milwaukee, Wis.
Vice-Chairman—William N. Lisch, Lisch Electric Co., Milwaukee, Wis.
Secretary-Treasurer—William C. Kuhnke, Wisconsin Electric Power Co., Milwaukee, Wis.
Board of Managers—M. H. Brucsewitz, T. B. Dustin, J. H. Hausler, R. F. Vandenboom.

Montreal Section

Chairman—Allen G. V. Smith, Northern Electric Co., Montreal, Que.
Secretary—Charles Mertens, 117 Charles St., Valois, Que.
Board of Managers—Duncan Brooks, J. R. Cristel, D. W. Frick, B. J. Monaghan, V. W. Stubbings.

New England Section

Chairman—William B. Elmer, Wheeler Reflector Co., Boston, Mass.
Vice-Chairman—C. M. Holden, Champion Lamp Works, Lynn, Mass.
Secretary—Ralph L. Huse, Graybar Electric Co., Inc., Boston, Mass.
Board of Managers—W. L. Ball, J. F. G. Eichorn, Jr., N. E. Ticehurst, R. W. Wilson.

New Orleans Section

Chairman—Jacob M. Gensburger, New Orleans Public Service Inc., New Orleans, La.
Vice-Chairman—S. Conrad Berdon, New Orleans Public Service Co. Inc., New Orleans, La.
Secretary—Walter T. Faber, Louisiana Power & Light, New Orleans, La.
Board of Managers—Edna P. Fortier, L. M. Goodman, C. C. Kleinschmidt, A. C. Roche.

New York Section

Chairman—Louis Goren, Smithcraft Lighting Division, A. L. Smith Iron Co., New York, N. Y.
Vice-Chairman—G. G. Rao, Holophane Company Inc., New York, N. Y.
Secretary—H. A. Anderson, Duro Test Corp., North Bergen, N. J.
Board of Managers—J. S. Hamilton, J. F. MacDougall, E. B. Manning, H. J. Peters.

Northern California Section

Chairman—Harold A. Wright, 225 Kearny St., San Francisco, Calif.
Vice-Chairman—Paul S. Schmidt, General Electric Co., Oakland, Calif.
Secretary—C. W. Macy, Pacific Gas & Electric Co., San Francisco, Calif.
Board of Managers—J. E. Barnes, F. M. Falge, R. E. Lagerstrom, R. W. Thunen.

Ohio Valley Section

Chairman—Beattie M. DeLong, 52 Woodland, Ft. Thomas, Ky.
Secretary—Edward J. McGinnis, Cincinnati Electrical Assoc., Cincinnati, Ohio.
Board of Managers—D. E. Baker, W. J. Fetzer, H. K. Flint, V. G. McClusky, R. A. Rosteck.

Oregon Section

Chairman—Donald W. Edmundson, 325 Henry Building, Portland, Ore.
Vice-Chairman—Dudley D. Moore, Benjamin Electric Mfg. Co., Portland, Ore.
Secretary-Treasurer—Dwayne E. Seely, Westinghouse Electric Corp., Portland, Ore.
Board of Managers—R. M. Boynton, A. B. Evans, M. S. Prestwood, Jr., F. E. Webb.

Philadelphia Section

Chairman—G. W. Wagner, Philadelphia Electric Co., Philadelphia, Pa.
Vice-Chairman—W. R. Mackinney, Westinghouse Electric Corp., Philadelphia, Pa.
Secretary—R. L. Horr, Philadelphia Electric Company, Philadelphia, Pa.
Board of Managers—F. N. Cooper, R. B. Engheuser, D. D. Lees, P. B. Thorne.

Pittsburgh Section

Chairman—Hugh S. James, Duquesne Light Co., Pittsburgh, Pa.
Vice-Chairman—James P. Boyden, Jr., Westinghouse Electric Corp., Pittsburgh, Pa.
Secretary—James A. Hodges, Jas. H. Hodges Co., Pittsburgh, Pa.
Board of Managers—W. A. Eisenhauer, J. R. Emery, C. J. Long, H. S. Orton.

Puget Sound Section

Chairman—G. Donald King, Sylvania Electric Products Inc., Seattle, Wash.
Secretary—Garland R. Barlogi, Sylvania Electric Products Inc., Seattle, Wash.
Board of Managers—C. C. Fields, K. E. Hollingsworth, C. R. Nelson, D. D. Scarff, B. A. Travis.

Rochester Section

Chairman—William S. Barclay, 91 St. Paul St., Rochester, N. Y.
Secretary—Melrose M. Franklin, Rochester Gas & Electric Co., Rochester, N. Y.
Board of Managers—R. M. Conheady, H. G. Linder, F. H. Owen, F. J. Schmitt, R. B. Thompson.

Rocky Mountain Section

Chairman—Glenn B. Gaer, C. P. Belt Co., Denver, Colo.
Vice-Chairman—L. J. Carlon, Albert Sechrist Mfg. Co., Denver, Colo.
Secretary-Treasurer—A. E. McKittrick, 1766 Kingston St., Aurora, Colo.
Board of Managers—Leigh Congdon, D. Q. Ford, J. L. Vanneman, C. O. Woodworth.

St. Louis Section

Chairman—E. W. Stohlmann, Jr., Union Electric Co., St. Louis, Mo.
Vice-Chairman—R. J. Welch, R. J. Welch Co., St. Louis, Mo.
Secretary-Treasurer—R. D. Cohen, Glasco Electric Co., St. Louis, Mo.
Board of Managers—Brooks Chassaing, H. J. Poehling, J. J. Rhoades, L. M. Wallace, Jr.

San Jacinto Section

Chairman—Edward C. Ober, Southern Electric Supply Co., Houston, Texas.
Vice-Chairman—Curt W. Grevelius, P. O. Box 2221, Houston, Texas.
Secretary-Treasurer—John F. Dill, Sylvania Electric Products Inc., Dallas, Texas.
Board of Managers—B. L. Cook, H. G. Hrivnatz, A. M. Rice, H. D. Weisser.

Southern California Section

Chairman—Roy H. Kreyser, Dept. of Water & Power, Los Angeles, Calif.
Vice-Chairman—George A. Hochenauer, Benjamin Electric Mfg. Co., Los Angeles, Calif.
Secretary-Treasurer—Merle A. Potter, Smoot-Holman Co., Inglewood, Calif.
Board of Managers—F. E. Blair, F. G. Hagadorn, H. A. Knoll, Del Reynolds.

(Continued on page 20A)

BADGE CONTAINER, made for the St. Louis Section by Ted Beyert of Locust Lighting Inc., a Section member, keeps members' badges in orderly fashion between meetings. Shown here with the container is Frank R. Niederkorn, vice-chairman of the Program Committee.

FLORA BALLAST* SHOWS how easy it is to make across-the-counter in-warranty replacement of G-E ballasts at no cost to you, from your nearby G-E Ballast Service Center Distributor. They carry ample stocks of G-E ballasts from which you can select replacements for any make ballast.

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When it is necessary to obtain an immediate ballast replacement you'll get prompt service at the G-E Ballast Service Center Distributor located nearest you. The complete stocks and convenient location help you save time and money. There are G-E Ballast Service Centers in every major city—more than 800 of them in the United States. Here you can make NO CHARGE in-warranty replacements of G-E ballasts . . . and replace *any make* ballast with a high quality G-E unit. And G.E. gives you top quality at low attractive prices too. Save time and money—solve your ballast replacement problems at your nearest G-E Ballast Service Center.

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*Miss Fluorescent Ballast, G.E.'s Ballast Mascot

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EXPERIENCED G-E BALLAST ENGINEERS are available to help you plan and service fluorescent lighting applications. For help, contact your nearest G-E Apparatus Sales Office.

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GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

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- SUPERIOR QUALITY CONTROL
- LONGER BALLAST LIFE
- PRECISE LAMP-MATCHED DESIGN
- PROVED PRODUCT LEADERSHIP

Progress Is Our Most Important Product

GENERAL ELECTRIC

(Continued from page 18A)

SOUTHWESTERN SECTION

Chairman — John E. Metzenthin, Crouse Hinds Company, Dallas, Texas.
Vice-Chairman—John B. Deck, Jr., Texas Power & Light Co., Dallas, Texas.
Secretary—Elmer L. Cole, Dallas Power & Light Co., Dallas, Texas.
Board of Managers—J. G. Felton, Jr., A. M. Gaynor, W. G. McKeithen, T. L. Moore.

TAR-HEEL SECTION

Chairman—Coy C. Jordan, Carolina Power & Light Co., Raleigh, N. C.
Vice-Chairman—A. L. Ducker, Jr., General Electric Co., Greensboro, N. C.
Secretary-Treasurer—James J. Cardo, Independent Electric Supply Co. Inc., Charlotte, N. C.
Board of Managers—E. K. Kraybill, J. A. Lowe, R. C. Marshall, E. D. Stevens.

TENNESSEE VALLEY SECTION

Chairman — Charles H. Patterson, 300 Cumberland Circle, Donelson, Tenn.
Secretary—Joe Willis Fowler, 709 Greymont Drive, Nashville, Tenn.
Board of Managers—May Love Gale, James B. Harrell, S. B. LeCorne, J. N. Stansell, W. B. Taylor.

TORONTO SECTION

Chairman—K. R. Dunphy, Canadian General Electric Co. Ltd., Toronto, Ont.
Vice-Chairman — G. E. Davidson, Hydro-Electric Power Commission, Toronto, Ont.
Secretary—E. I. Mahtinger, Crouse-Hinds Co. of Canada Ltd., Toronto, Ont.
Board of Managers—V. W. Diak, A. W. Henschel, R. F. Lindsay, J. A. Watt.

TWIN CITY SECTION

Chairman—Cecil H. Branham, Box 27, St. Louis Park Station, Minneapolis, Minn.
Vice-Chairman — A. A. Aronson, Northern States Power Co., Minneapolis, Minn.
Secretary-Treasurer—G. W. Frederick, 2135 Orchard North, Minneapolis, Minn.
Board of Managers — Edward Hoffmann, Albert W. Lange, Thomas E. Roche, Don R. Schwarz.

UTAH SECTION

Chairman—Sigurd A. Blomquist, Blomquist & Brown, Salt Lake City, Utah.
Vice-Chairman—W. F. Mulcock, Utah Power & Light Co., Salt Lake City, Utah.
Secretary—Robert W. Darger, The Darger Co., Salt Lake City, Utah.
Board of Managers—E. N. Christofferson, L. B. Johnson, J. W. Lowder, D. H. White.

WESTERN MICHIGAN SECTION

Chairman—L. G. Thompson, Independent Electric Co., Muskegon, Mich.
Vice-Chairman—W. Dale Crites, Day-Brite Lighting Inc., Grand Rapids, Mich.
Secretary—D. A. Harper, G. E. Supply Corp., Grand Rapids, Mich.
Board of Managers—J. A. Albertson, W. T. Bronson, A. A. Holcomb, William Winglar.

WESTERN NEW YORK SECTION

Chairman—Willard E. Hayes, General Electric Co., Buffalo, N. Y.
Secretary-Treasurer — Fred R. Pfalzgraf, 1612 Main St., Buffalo, N. Y.
Board of Managers— F. B. Burke, E. G. Goldsmith, Neal Jacobus, B. F. Lyth, Jr., B. H. Plante.

Utah Residence Lighting Forum Reports on Year's Activities

Residential lighting and how to sell it has been the subject for three meetings since the first of the year for the newly organized Residence Lighting Forum of the Utah Section of I.E.S.

An indication of the interest aroused in these meetings is shown by the time they are held: busy dealers, distributors, manufacturers representatives and utility personnel get together for a Forum meeting at breakfast! Speakers, both local and from out of the Section have been heard. The three meetings this year were as follows:

An Interior Decorator Works with Lighting — Jean Bronner, Salt Lake City.
New Trends in Lighting — Charles Long, Westinghouse Lamp Division, San Francisco.
Techniques in Selling Lighting—M. E. Freyer, Aurora Lamp Co., Chicago.

Officers of the Forum for the past year have been: Dale Brown; Leo Hansen; Evelyn Hansen, Chairman; and Thomas Felt, Secretary.

BREAKFAST session of the Utah Section Residence Lighting Forum, March 19, featured guest speaker, Charles R. Long, Westinghouse Electric Corp., from San Francisco.

Eight Certified Lighting Bureaus Now Established

There are nearly three-quarter million industrial and commercial customers in the areas covered by local Certified Lighting Bureaus, according to a report by National Lighting Bureau Manager L. C. Messick, to the Industrial and Commercial Lighting Equipment Section of NEMA. In the eight areas in which five bureaus are already in operation, and in which three more are scheduled to commence Autumn operation, there are a total of 708,946 meters, he reported.

Presently in operation are bureaus covering: Rhode Island, centered at Providence; Eastern Massachusetts, centered at Boston; Indianapolis; Northern California, centered at San Francisco; and San Diego County, Calif.

Scheduled to begin operations in the Fall are bureaus centered at Charlotte, N. C., Cincinnati, Ohio, and Detroit, Mich.

British IES Elects New Officers

At the Annual General Meeting of the British Illuminating Engineering Society held in London, May 10, the President, E. C. Lennox, announced the names of the officers and new members of Council to take office next October. They are:

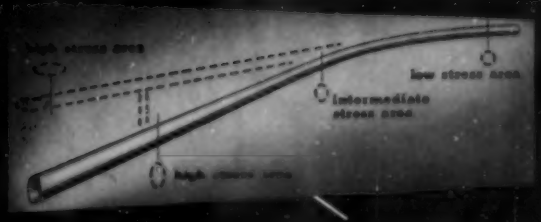
President — A. C. Higgins, Assistant, Secretary, Institution of Gas Engineers.
Vice-Presidents — G. E. L. Comrie, Holophane, Ltd.;
J. W. Howell, Lighting Service Bureau;
A. G. Penny, General Electric Co., Ltd.;
R. W. Steel, South Western Electricity Board;
Dr. J. W. Strange, Thorn Electrical Industries, Ltd.
Treasurer — E. B. Sawyer, Lighting Service Bureau.
Secretary — J. G. Holmes, Holophane, Ltd.
Editor of Transactions — C. R. Bicknell, Siemens Electric Lamps and Supplies Ltd.
New Members of Council — C. R. Bicknell, H. Carpenter, H. F. Gillbe, W. E. Rawson-Bottom, John Reid, N. C. Slater, W. J. P. Watson, A. H. Young.

Scientific Manpower Shortage Reported by Industry Survey

At least half of 200 large companies engaged in research and development — all of them in essential industries — report shortages of research scientists and engineers, according to Dr. Alan T. Waterman, Director of the National Science Foundation.

Dr. Waterman was making public preliminary findings of a study of industrial research being made by the Bureau of Labor Statistics as part of the Founda-

(Continued on page 23A)



FIRST to provide ample strength in all-aluminum arms and arm-shaft joints through patented, seamless elliptical arms requiring no bracing for lengths up to 8 feet. On longer arms, one horizontally elliptical member, integrally welded to the arm, eliminates need for side-sway bracing.

FIRST to develop fabricating equipment and methods to permit use of high strength aluminum alloys.

FIRST to develop and produce seamless, tapered shafts from high-strength, extruded tubing in a wide range of diameters.

Seven firsts . . . . . All are P&K

FIRST to pioneer the Aircomatic method of welding for fast, strong welds and negligible deterioration of alloy strength. All P & K welds are guaranteed . . . all P.& K welding personnel and equipment is certified by U. S. Government agencies.

FIRST to stress use of castings of heat-treatable aluminum alloy, and first to introduce permanent mold castings for transformer bases, shoe and pedestal bases . . . with smooth surfaces and strong grain structure.

FIRST to eliminate unnecessary scrolls, tie-rods and other ornamental frills.

FIRST to design and build its own tapering machine to handle all diameters of extruded aluminum tubing.

P & K . . . Producer of America's Most Modern All-Aluminum Standards and Brackets

FOR LIGHTING

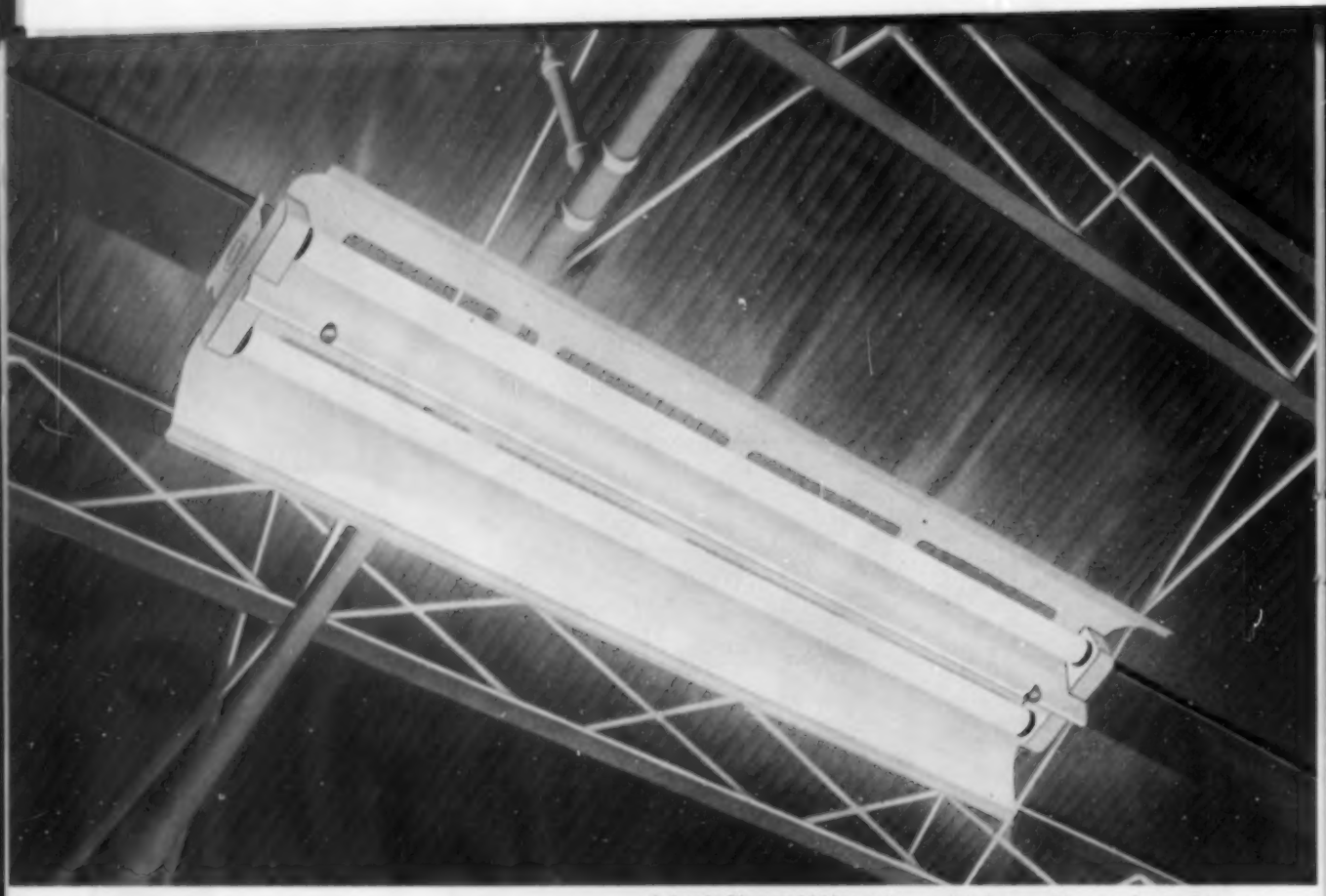
TRAFFIC SIGNAL POSTS — TRAFFIC AND COMMERCIAL SIGN POSTS

SEVEN P & K FIRSTS! They add up to this: P & K All-Aluminum Standards, Arms and Posts do the job better, easier and at far less cost than any other "pole" of any other material or design.

WRITE FOR THE NEW P & K CATALOG . . . and use the planning and advisory services without obligation.

Pfaff & Kendall

84 Foundry Street
Newark 5, New Jersey



Sylvania Diamond-I Line. Like a polished gem with many facets, this new semi-direct fixture transmits *more* light—delivers a full 25% upward component, and an extremely high illumination efficiency of 89%.

THE NEW SYLVANIA Diamond-I SERIES
—*Untraps all usable light*

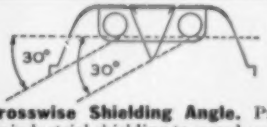
Introducing the pace-setter of an entirely new trend in plant illumination—the Sylvania *Diamond-I*. This semi-direct fixture releases light and heat that would normally be "trapped" between the reflector and the tops of the fluorescent lamps in other fixture types. It puts more light to work—provides an extremely high illumination efficiency of 89%!

In meeting or exceeding all the new RLM improved requirements for lighting, the *Diamond-I* directs a full 25% of its light upward through reflector slotting. This illuminates ceiling areas above fixtures, eliminates sharp contrasts overhead, reduces harsh shadows and glares. Its porcelainized reflector-shield spreads a full, even illumination over working areas below.

Designed for one-man maintenance, the Sylvania *Diamond-I* Line is engineered to cut costs to the bone. Each unit consists of only two major components—a complete channel assembly and an easily removed reflector-shield assembly. Whether an installation calls for 4- or 8-foot units, the reflector-shield is always a lightweight, easy-to-handle 4 feet long. Slots in shielding produce upward draft which carries away dust particles that would normally settle on lamps and reflectors.

• • •

You can recommend the Sylvania *Diamond-I* Line as a real investment in better plant illumination, longer fixture life, improved seeing and working conditions. Send the coupon for more detailed information.



30° Crosswise Shielding Angle. Provides superior industrial shielding to guard eyes from direct glare of lamps.

Ease of Maintenance
One-piece 4-foot reflector-shield—easy for one man to remove for cleaning. Multi-socket lampholders simplify lamp changes.

SYLVANIA®

. . . fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS • TELEVISION ATOMIC ENERGY

Sylvania Electric Products Inc.
Dept. G30, One 48th Street, Wheeling, W. Va.

☐ Please send me detailed information on the new Sylvania *Diamond-I* fixture.

☐ Have a Sylvania lighting specialist call on me.

Name_____ Title_____

Firm_____

Address_____

City_____ Zone____ State____

(Continued from page 20A)

tion's national survey of scientific research and development. Dr. Waterman declared that the 200 companies interviewed in the study employ a substantial proportion of all scientists and engineers engaged in industrial research. About two-thirds of the companies with shortages reported that the shortages were major. All companies agreed on the need for better qualified, more highly trained scientists and engineers. A sizeable number of firms said they had been forced to curtail projected increases in research and development programs, because of lack of qualified personnel.

The Foundation annually awards about 700 graduate fellowships in the sciences; and its programs of basic research support and research education are designed to help meet the growing needs for scientists and engineers.

RECOGNITION of his service in improving the street lighting in Washington, D. C., is awarded to Herbert Friede, member of the Capital Section, I.E.S. Here, left to right, are Commissioner Thomas Lane; A. L. Jagoe, President, Washington Junior Chamber of Commerce; Mr. Friede, and Commissioner Sam Spence.

Civic Group Honors D. C. Street Lighting Engineer

A commendation by the Junior Chamber of Commerce of Washington, D. C., was the subject of a resolution by that group recognizing the service of Herbert A. Friede, member of the Capitol Section, I.E.S. and electrical engineer with the Department of Highways, Government of the District of Columbia. The honor, which was presented May 12 to Mr. Friede, reads in part: "Whereas, Mr. Herbert A. Friede and his associates . . . have been instrumental in bringing to the streets of Washington both more efficient and less expensive lighting, resulting in a substantial reduction in accidents and traffic violations, particularly pedestrian injuries and speeding violations . . . "

Drive-In Theater Screen Brightness Surveyed by SMPTE

Average screen brightness in drive-in theaters is 3.0 footlamberts as compared to the indoor standard of 9-14 footlamberts, it was revealed in a preliminary survey conducted by the Screen Brightness Committee of the Society of Motion Picture and Television Engineers. The results of this survey, which was undertaken to ascertain the practical operating problems of drive-in theaters, and to assess the possibilities for changes in existing theaters were made known at the 77th semi-annual convention of the group in Chicago last April.

For the past year and a half the Screen Brightness Committee has been making measurements in 26 drive-in theaters in the eastern and central states, with wide screen widths about equally divided between the 40-60-foot and 60-120-foot range. Although the measured group represents only 0.6 per cent of the more than 4000 drive-in theaters in the country, the survey provided much useful information about this type of exhibition that accounts for about 23 per cent of all the theaters and at least 20 per cent of the box office gross.

New York Residence Lighting Forum Awards Student Prizes

Winners of the Lighting Design Competition for New York City High School students, sponsored by the New York Residence Lighting Forum, were announced at the annual Spring party of the Forum, May 26, at the Central High School of Needle Trades.

The competition, which was open to all girl students in the vocational high schools in the city, involved making complete plans for the artificial lighting of a typical split-level residence. Contestants were given the floor plan of the house showing furniture arrangements and information as to the habits and interests of the family for whose activities the lighting is provided. Entries were judged on the success with which they solved the lighting problems, consideration being given to practicality, comfort and aesthetic merit, as well as to the technical rendering of the presentation.

Mathew A. Veeck, Chairman of the Competition, and Harry Lewis, Coordinator of Curriculum Development for vocational high schools for the Board of Education, were in charge of arrangements in the schools. Judges were Berlon Cooper, *Electrical Construction and Maintenance;* Miss Lillian Eddy, home lighting specialist with General Electric; and Thomas Smith Kelly, lighting consultant.

Eight awards were made:

First—Patricia O'Connell
Second—Elizabeth Sanchez
Third—Marie Sanchez
Merit Awards—Louise Piaggio, Olga Roman, Sandra Faust, Diana Renta and Carmen Ortiz.

Representatives of the Board of Education and the school system attended the meeting as guests. The entries were on display during the afternoon session.

At another recent meeting, June 8, the Forum made an inspection trip to see the outdoor lighting at "Kelly's Barn," the summer home of Thomas Smith Kelly, in Connecticut, where the trees and shrubbery are illuminated by concealed lighting units designed by Mr. Kelly. Approximately 60 members made the trip.

Latest CLI Clinic — On Automobile Display Lighting

Most recent in the series of lighting clinics for specific applications, sponsored by the Chicago Lighting Institute in cooperation with the Chicago Section, I.E.S., was on Lighting for Automobile Display Rooms, Service Areas and Used Car Lots. Another sponsor of this particular clinic was the Chicago Automobile Trade Association. The full-day sessions were held June 16 at the Institute.

The morning program was under the chairmanship of Frank H. Yarnall, President of the National Automobile Dealers Association, and was opened by Carl W. Zerseu, Managing Director of the Institute. The following topics and speakers were heard:

Fundamentals of Lighting and Seeing — Raymond Wozniak, Lighting Engineer, Chicago Lighting Institute.

Lighting for the Showroom — Robert T. Dorsey, Application Engineer, General Electric Co., Cleveland, Ohio.

Lighting for Service and Repair — Elden H. Witte, Lighting Engineer, Benjamin Electric Mfg. Co., Des Plaines, Ill.

Lighting for Used Car Lots — John A. McDougall, Sales Manager, Revere Electric Mfg. Co., Chicago.

The afternoon program, following lunch at Carson Pirie Scott & Co., was under the chairmanship of Edward L. Cleary, General Manager, Chicago Automobile Trade Association. Subjects and speakers were as follows:

Operating Costs of Lighting — Francis M. Bunker, Public Service Co., Division of Commonwealth Edison Co.

Maintenance of Lighting — Richard Smart, Regional Lighting Engineer, Sylvania Electric Products, Inc., Melrose Park, Ill.

Miscellaneous Lighting Applications —
Outdoor Signs—Entrances—Building Fronts — Robert Thompson, Federal Sign & Signal Corp., Chicago.
Offices and Reception Rooms—James Weeks, Lighting Engineer, Westinghouse Electric Corp., Chicago.
Infrared Applications — Larry Goble, Fostoria Pressed Steel Co., Chicago.

Quiz Panel and Summary — Carl F. Jensen, Regional Lighting Engineer, Westinghouse Electric Corp., Chicago.

Chairman of the Conference Planning Committee was Joseph F. Herbenar, Lighting Engineer, General Electric Co., Chicago.

Architectural Students Compete In Southern California Project

This year's assignment was "Lighting a School Classroom" in the annual competition for architectural students, sponsored by the Southern California Sections of I.E.S. and the American Institute of Architects. Prizes were awarded at the joint meeting of the two groups, May 4 at the Roger Young Auditorium in Los Angeles.

Judges in the contest were Harold Hall, Clayton T. Gibbs, and Alvin J. Smith for I.E.S., and Herbert Powell, Maynard Lyndon and Don Gill for A.I.A. Winning students are shown in the photograph.

The evening's program, in addition to the prize awards, centered around the joint interests of lighting engineers and architects, with topics and speakers as follows:

Light and Architecture — Arthur B. Gallion, Dean, USC School of Agriculture.

A.I.A. Viewpoint of the Competition — Herbert Powell, A.I.A.

I.E.S. Viewpoint of the Competition — Alvin J. Smith, Electrical Engineer, with H. L. Gogerty, Architect.

Progress on the I.E.S. Recommended Practice of School Lighting — Charles Gibson, Supervisor, Division of School House Planning, State of California.

Visual Data for Lighting Design — Philip F. O'Brien, Lecturer in Electrical Engineering, UCLA.

Chairman of the evening was Foster K. Sampson, and F. Edwin Blair, Chairman of the Southern California Section, I.E.S., presented the awards.

WINNERS of the annual IES-AIA Architectural Students Lighting Design Competition, sponsored by the Southern California Section, were presented with their awards at the Section's May 4 meeting. Left to right are: first, $100, L. Don Miller; second, $50, Leslie W. Traeger; third, $25, H. Robert Thomas; and runners-up, $10, Randell Makinson, Donald Case and Wally Welch. All are students at the University of Southern California School of Architecture.

Residence Lighting Resource List Available from Headquarters

A 29-page bibliography, compiled by the I.E.S. Residence Lighting Committee, entitled the Residence Lighting Resource List, is available free of charge from the I.E.S. Headquarters Office, Technical Department.

The list was compiled especially for educators, home advisors and students of home lighting as a guide to current authoritative sources of associated study, research, development and recommended practice. Titles and a short description of each publication are classified according to the following categories: nature of light, light and vision, light sources, luminaires, lighting design principles, recommended lighting methods, housekeeping functions, architecture, interior design and furnishings, color, wiring and visual and teaching aids.

Society Secretaries Meet in Philadelphia

The I.E.S. was represented at the May 24-25 meeting of the Council of Engineering Society Secretaries by A. D. Hinckley, Executive Secretary. This two-day meeting was held at the Engineers' Club in Philadelphia. Apart from the luncheon and dinner talks, four panel discussions were held on publications, meetings, engineering society administration and other administrative problems. Mr. Hinckley was a member of the panel contributing to the discussion on finan-

(Continued on page 26A)

CEILING IN SPACE FRAME STRUCTURE FEATURES TRANSLUCENT PANELS OF EXTRUDED LUCITE®

Two-story research laboratory at Ann Arbor embodies new concept in design

A STUDENT in the College of Architecture and Design installing a 4' x 4' translucent panel of "Lucite" acrylic resin. The experimental laboratory consists of an enclosed area, 33 by 49 feet beneath a 70- by 90-foot roof. The drafting area on the lower level of the enclosed area uses a ceiling of Du Pont "Lucite" acrylic resin for transmitting optimum light without glare.

"Durable, flexible, expandable, demountable and reusable." That's one professor's description of the new research laboratory at the University of Michigan. The Unistrut Space Frame System introduces a third dimension of reinforcement—diagonal struts to distribute stress in three directions. As a result, supporting columns are needed only at widely spaced intervals and interior walls carry none of the roof load.

The walls, ceiling, and roof utilize many 4' x 4' translucent and transparent panels. For example, on the lower level under the north mezzanine the ceiling is constructed of Du Pont "Lucite" acrylic resin. These lightweight modular units of "Lucite" were extruded by Gering Products, Inc., of Kenilworth, New Jersey. They transmit all wave lengths of visible light, are glare-free. Panels of "Lucite" are exceptionally strong and can withstand direct and prolonged exposure to sunlight and weathering without discoloring or crazing.

"Lucite" permits unusual decorative effects. It comes in a wide variety of transparent and translucent colors. Extruded "Lucite" acrylic resin can be fabricated into troffer-type panels and corrugated shapes to meet any custom design specifications.

For further information on "Lucite" acrylic resin—its properties and uses as a lighting material—write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 287, Du Pont Building, Wilmington 98, Delaware. In Canada: Du Pont Company of Canada Limited, P. O. Box 660, Montreal, Quebec.

Good Lighting Is Good Business

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

(Continued from page 24A)

cial administration, office management and financial support. Representatives of some 40 national, regional and local engineering societies were in attendance. The president of the group for 1954-1955 was Edward H. Robie, Secretary Emeritus of the American Institute of Mining and Metallurgical Engineers.

New Automobile Headlamps Authorized by All 48 States

Sale and use of the new automotive headlamp has now been authorized by all of the 48 states. The improved sealed beam unit was publicly announced last Fall (see December 1954 I.E., page 12A). Changes in headlamps require the approval of motor vehicle officials throughout the country, and in many states legislative changes were necessary to amend motor vehicle codes. The completion of this work has now been announced.

ATTENDANCE was 52, representing fixture manufacturers, consulting engineers and architects, at the ten-week Practical Course in Lighting Design and Layouts, sponsored February 28 to May 2 by the New York Section of I.E.S. Faculty consisted of R. L. Zahour, Westinghouse Lamp Division; P. Herrick, G-E Lamp Division; Lou Goren, Smithcraft Lighting; and G. G. Rae, The Holophane Co. For details on the program covered, see March IE, page 14A.

ABOUT PEOPLE

Selection of key personnel for the newly-formed Large Lamp Department of General Electric's Lamp Division has been virtually completed, **Herman L. Weiss**, general manager, has announced. The department is the largest of six product departments into which the Lamp Division was divided recently in a complete reorganization. It will be responsible for the development, manufacture, distribution and sale of general lighting lamps, incandescent, fluorescent and mercury. The department will make its headquarters at Nela Park.

Six persons will be responsible to the general manager. They are: **Ralph H. Humbert**, manager of marketing; **Donald J. Mayer**, manager of warehousing and field service; **Henry F. DeLong**, manager of manufacturing; **Vernet C. Kauffman**, manager of engineering; **Roy L. Johnson**, manager of finance; and **Henry F. Donahower**, acting manager of employee and plant community relations.

The marketing organization will include 11 home office managers and 32 managers of existing sales districts in all parts of the country. Managers at Nela Park headquarters are: **John M. Lime**, retail sales; **Arthur C. Barr**, commercial and industrial sales; **Edward D. Stryker**, utility sales; **Robert V. Corning**, marketing administrative; **Robert E. Worstell**, with **John R. Colville** as consultant, personnel development; **James C. Forbes**, market development; **Martin R. King**, advertising; **Allen K. Gaetjens**, product planning; **Willard C. Brown**, application engineering; **Robert L. Oetting**, Lighting Institute; and a market research manager, **John N. Paddock**.

Changes in the management of nine sales districts are reported: Chicago Sales District, **Frederick F. Denny** replaces **T. Douglas Scarff**, who remains as consultant; Virginia Sales District, Richmond, **Dean N. Jenks** replaces **Willard S. Hemker**; Ohio Valley Sales District, Cincinnati, Mr. Hemker replaces **Robert V. Corning**; Mohawk Sales District, Albany, **Joseph B. Foley** replaces **Gomer F. Davis**; Buckeye Sales District, Cleveland, **George S. Trotter** replaces Mr. Lime; Texas Gulf Sales District, **T. C. Lauck** replaces Mr. Trotter; New York Sales District, **Everett G. Agee** replaces **Harold A. Olson**; Niagara Sales District, Buffalo, **Arthur C. Kircharts** replaces **Robert E. Jordan**; and Delta Sales District, New Orleans, **Gordon E. Brown** replaces Mr. Lauck.

Reporting to Mr. Mayer will be four home-office managers and the managers of 20 existing service districts. Home office managers are: **Harry P. Thatcher**, office operations; **James B. DeArment**, traffic; **Hugh G. Mutchler**, warehousing; and **Walter H. Frick**, Nela Press.

Mr. DeLong will have reporting to him plant engineering manager **H. M. Filkins**; manufacturing engineering manager **James C. Stitt**; production control manager **Herbert W. Ellis**; and the managers of 10 lamp plants.

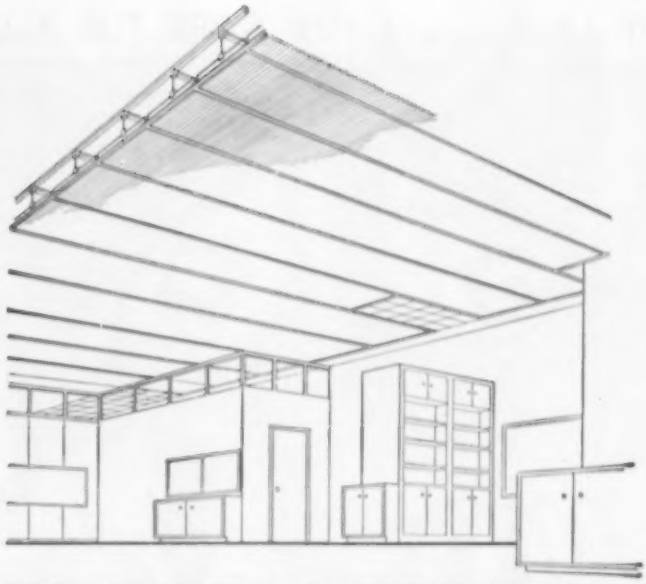
Reporting to Engineering Manager Kauffman are **Bernard R. Buss**, product engineering manager; **Edward B. Noel**, incandescent lamp product engineering manager; **Richard N. Thayer**, discharge lamp product engineering manager and **Melvin A. Lakness**, manager of product evaluation and performance.

Appointments in another newly-formed department of the General Electric Lamp Division have also been announced. **James A. Rafert** has been named Supervisor of Marketing Research for the Photo Lamp Department, and **Thomas H. Castle** has been appointed to the position of Supervisor of Advertising and Sales Promotion for the department.

Joseph F. Miller has been appointed Managing Director of the National Electrical Manufacturers Association, by the Board of Governors at its May 5 meeting. Mr. Miller, who has been Assistant Managing Director for the past year, succeeds **William J. Donald**, who retired April 30 after serving NEMA in that post for nearly 21 years.

(Continued on page 29A)

At last a flexible lighting system to meet all the needs of modern classrooms

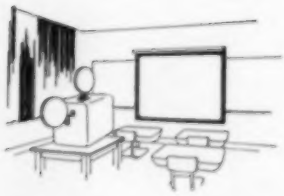


WAKEFIELD PHOTO-METRICS

GIVE THE ROOM PLANNER COMPLETE CONTROL OF THE LIGHT-DISTRIBUTION PATTERN REGARDLESS OF THE SIZE, SHAPE OR IRREGULARITY OF THE ROOM.

NO SIDE WALL CONTACT. Unlike standard luminous ceilings, Wakefield Photo-Metrics can be up to 30 inches from the side walls without affecting the light-distribution pattern. This saves the cost of exact fitting of diffusers and grids to walls, to structural members or to special equipment.

IRREGULAR PERIMETERS NO PROBLEM. In addition to pre-planned and packaged Photo-Metrics for standard rectangular classrooms, minimum Design Units in 3'x4', 3'x6' and 3'x8' are available. Thus alcoves and other special areas are no problem. The designer can lay out his Photo-Metrics to follow the perimeter of his classroom, even carrying the diffuser over the tops of movable walls.



SELECTIVE SWITCHING FOR AUDIO-VISUAL. "Dim-outs" rather than black-outs are needed for classroom projection. To reduce room brightness to screen brightness, you need large area, diffuse light sources such as Wakefield Photo-Metrics, which through selective switching can lower the quantity of light without altering its over-all distribution pattern.

WAKEFIELD PHOTO-METRICS

are flexible, economical, easy to install

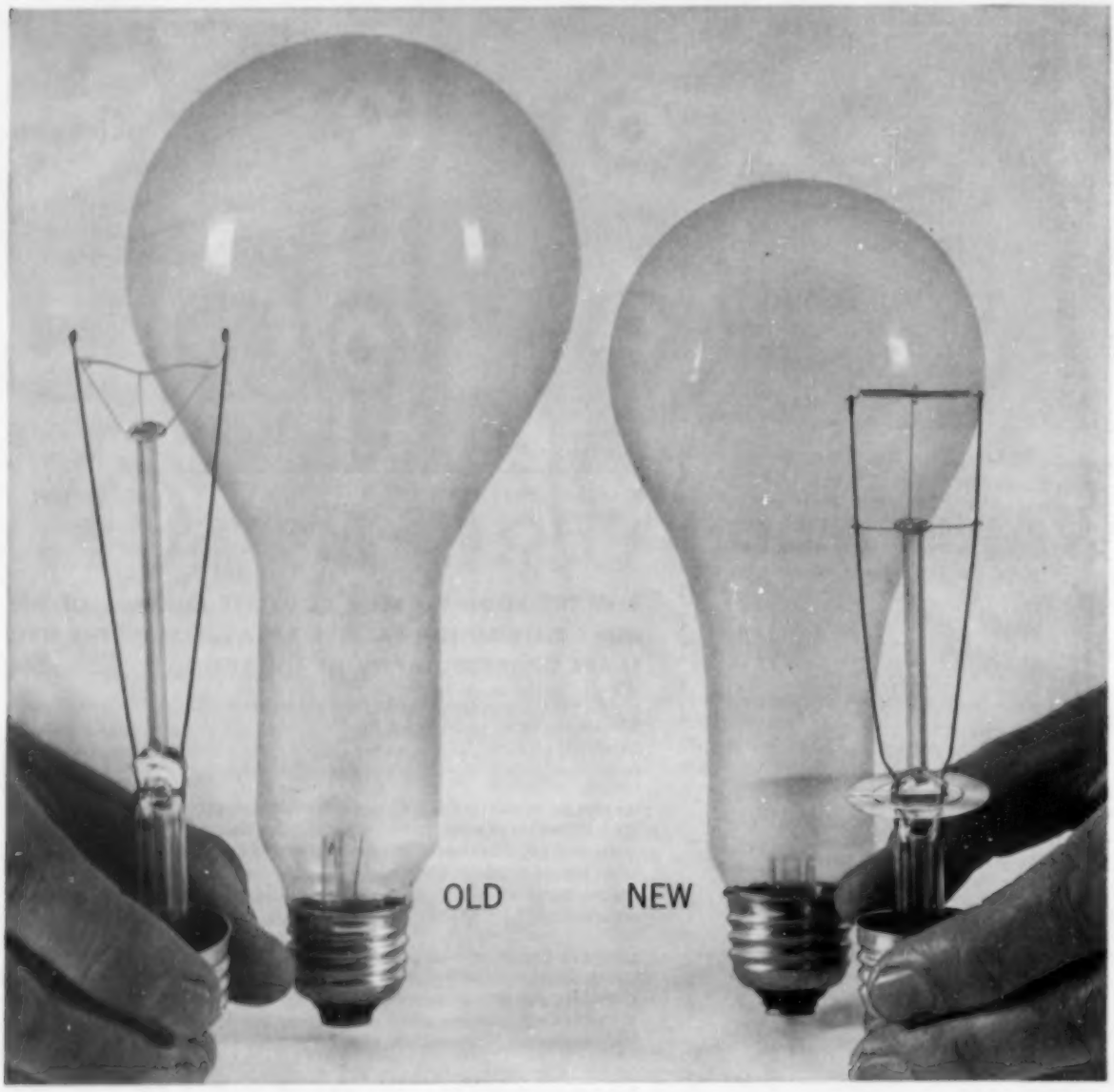
They consist of highly diffusing corrugated plastic panels of a specially formulated vinyl chloride, known as Wākon, suspended below a flexible fluorescent lighting system. The Wākon diffusers, which are non-combustible, are mounted in a free-suspended but rigidly locked grid which can be readily assembled to meet the lighting requirements and fit the structural limitations of various proportioned classrooms.

Told here are several of the basic advantages of Wakefield Photo-Metrics for modern classroom planning. Many others are described and illustrated in our new 40-page booklet called, WAKEFIELD LIGHTING: AS FLEXIBLE AS YOUR CLASSROOMS. *Write for one to The Wakefield Company, Vermilion, Ohio. In Canada: Wakefield Lighting Limited, London, Ontario.*

THE WAKEFIELD COMPANY
VERMILION, OHIO

WAKEFIELD LIGHTING LIMITED
LONDON, ONTARIO

G-E LAMPS GIVE YOU MORE FOR ALL YOUR LIGHTING DOLLARS



New General Electric 200-watt bulb takes less space, but gives more light

A NEW General Electric 200-watt bulb, shorter and slimmer than the old one, fits into fixtures and lamps that would formerly take nothing larger than a 150-watt bulb.

The new G-E bulb gives about 3% more light than the old one. In the new bulb, the filament is an efficient *coiled* coil, which needs only one support. The filament of the old bulb is a single coil which needs three fine-wire supports. Although these support the filament firmly, they tend to cool it and slightly reduce the light. Based on average operating costs, the extra light of the new bulb is worth 7¢ to 10¢ over the life of the bulb.

Though the new design puts the hot filament closer to the base, the new General Electric 200-watt bulb is safe to use even in paper-lined sockets. That's because of a heat-reflecting disc of aluminum between the base and the filament.

With all this extra value built in, the new bulbs list at a penny *less* than the old. For more facts on how General Electric gives you more for *all* your lighting dollars, write for a 16-page G-E progress report to lamp users. It's free, just write General Electric Company, Dept. 482-IE-7, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

(Continued from page 26A)

W. A. Rogers, one of the organizers of Marlin Associates, has opened his own wholesale electrical firm, Rogers Electric Supply Co. at 3064 Mockingbird Lane at Airline Road, Dallas, Texas. Mr. Rogers is President of the new firm, with **Harold Danchik** as Vice-President.

Jack A. Frost, specialist in mobile lighting equipment, has opened a new office in Toronto. **Jim Fuller** has been named manager of this office, which is at 425 Burnamthorpe Rd., Toronto, Ont.

Percy F. Fletcher, formerly with Canadian General Electric Wholesale Division, has been named District Engineer of the Canadian G-E Lamp Division for the Pacific District, in Vancouver, B. C. While in Victoria, Mr. Fletcher had served as Chairman of the Vancouver Island Chapter of I.E.S., in 1953-1954. In his new position he is replacing **Al Whitehead**.

Sylvania Electric Products Inc. has announced the appointment of **Otis R. Lail, Jr.**, to special representative for airport lighting. Mr. Lail will be particularly concerned with the company's centerline approach system, and with aircraft identification and directional beam systems.

The election of **Ruben Rosen** and **Maurice M. Rosen** as chairman of the board of directors and president, respectively, of Progress Manufacturing Co., Inc., residential fixture manufacturers, has been announced. Ruben Rosen was previously president of the firm and Maurice Rosen had been secretary and treasurer. Present secretary-treasurer is **Clarence Stern.**

McPhilben Manufacturing Co., Inc., Brooklyn, N. Y., has announced the appointment of **Edward L. Gluck** as New York Sales Manager of their Architectural Lighting Division. Mr. Gluck was formerly with the Holophane Co., Inc., as Application Sales Engineer and District Engineer for their New York office.

Joseph F. Kempf, Jr., has been named manager of the Penn-Jersey District of Westinghouse Lamp Division, with his headquarters in Philadelphia. Mr. Kempf was formerly manager of the Lake Erie District, which position will now be filled by Daniel R. Thomas. Mr. Thomas will direct his activities from Cleveland.

An Honorary Doctor of Engineering degree was awarded to **Ivan M. Kirlin**, of the Kirlin Co., at the commencement exercises June 5 of Purdue University. Mr. Kirlin had received his B.S. at Purdue in 1913.

Pittsburgh Reflector Co. announces the opening of a new branch office at 1005 Fox Bldg. in Philadelphia, to be headed by **Leroy Winters** and **Mitchell J. Davis**. The office will serve the area of Eastern Pennsylvania, Southern New Jersey, Delaware and Maryland. Mr. Winters was formerly in charge of lighting sales for Hopkin Bros., Inc., Philadelphia., and is a Past-Chairman of the Philadelphia Section, I.E.S. Mr. Davis, who was a Sales Engineer with Hopkin Bros. prior to joining with Pittsburgh Reflector, is a Past-Chairman of the Eastern Pennsylvania Section, I.E.S.

Pittsburgh Reector also announces the appointment of **Charles R. Shapard** as Lighting Representative for the Western Tennessee, Eastern Arkansas and Northern Mississippi territory of the company, with headquarters at 4927 Amboy St., Memphis, Tenn.

The University of Illinois has announced the recipients of three scholarships in Illuminating Engineering for the second semester of this year. Recipient of the Senior scholarship, established by the Chicago Section of I.E.S., is **Kenneth E. Fairbanks** of Park Ridge, Ill. The two junior scholarships, established by the Holophane Co., Inc., have been awarded to **Donald R. Arnold** of Belleville, Ill., and **Bruce E. Burgess** of Chicago.

The appointment of **Jerald D. Huggins** as senior salesman for the San Francisco district sales office of the Jefferson Electric Co. has been announced. Mr. Huggins joined Jefferson after five years in the sales department of the northern California district of Harvey Hubbell, Inc.

Robert J. Meunier has been named sales representative in the Kansas City area for the lighting and electronics division of the Mitchell Manufacturing Co., Chicago.

OBITUARIES

George Ainsworth, well-known pioneer in the lighting field and member of the Illuminating Engineering Society for over thirty years, died June 9, at the age of 75.

Mr. Ainsworth entered the lighting industry as a designer with the Edward F. Caldwell Company, New York City,

George Ainsworth

one of the earliest manufacturers of lighting equipment. By 1926 he was established as a consulting engineer on illumination, and started his own business designing and manufacturing luminaires.

One of his best known contributions was his theory of spatial brightness equilibrium, *i.e.* lighting the overhead so evenly as to effect shadowless light, with minimum glare, as found in daylighting at certain levels or times of day. He designed a number of original luminaires, based on this theory, one of these being the first fluorescent luminous indirect lighting system used in continuous runs.

Mr. Ainsworth was also a member of the British Illuminating Engineering Society and the Norwegian Society for the Development of Lighting.

André Claude, distinguished French illuminating engineer, recently President of l'Association Francaise des Éclaragistes, and also a member of this Society, died May 13 after a short illness. He was 55.

As President and General Manager of Établissements Claude, Paz et Silva, M. Claude was associated with many of the recent developments in the lighting industry, and was probably best known in this country for his contributions in the field of fluorescent neon tube sources.

M. Claude was an Officer in the Legion d'Honneur, a member of l'Academie des Sciences and of the Société Francaise des Electriciens.

I.E.S. Sections report with sorrow the deaths of the following members:

Paul E. Dunlap, Michigan Section.

Raymond Frischhertz, Sr., Past-Chairman, New Orleans Section.

Ray L. Lamberth, Northern California Section.

IT SEEMS TO ME

Illumination Levels

It seems to me that most of us have been overlooking something when we discuss recommended footcandle levels. For example, the American Standard Practice for School Lighting specifies a *minimum* of 30 footcandles on the classroom desk. We have been using this as though it meant: 'The *average* maintained footcandles on the desk shall not be less than 30." Strictly speaking, doesn't it mean: "The illumination on any classroom desk shall not fall below 30 footcandles at any time?"

The two interpretations produce widely different results. An installation calculated for an average maintained illumination of 30 footcandles with a maintenance factor of .60 would have a maximum of 50 footcandles and a minimum of 10. Even with a maintenance factor of .70, the maximum would be 43 footcandles and the minimum 17.

If we intend the 30 footcandles for schoolrooms to mean "average maintained," then we have a further answer to the occasional critics who argue that 30 is higher than necessary. We can point out that such an installation would provide only 10 to 17 footcandles just before a cleaning.

On the other hand, if we mean the 30 to be a true minimum, we should calculate as follows:

$$\text{Required number of luminaires} = \frac{30 \times \text{floor area}}{\text{total lamp lumens} \times CU} \times \frac{1}{\frac{30}{mf}(2mf - 1)}$$

where CU = coefficient of utilization,
mf = maintenance factor.

WILLARD ALLPHIN, *Sylvania Electric Products, Inc., Salem, Mass.*

I.E.S. Relationships

It would seem to me that I.E.S. people are the same the world over! May I call your attention to the following news note published in the British I.E.S. magazine (*Light and Lighting*, June 1955). They could well have been describing an I.E.S. dinner-dance in this country, and the fraternal relationships we all experience in our own Society.

"As we write, the battle of the parties seems hardly to have begun; by the time you read it we will all have forgotten the battle and will have resigned ourselves to whatever form of government we have democratically inflicted on ourselves for the next few years. One party which many of us will not forget in a hurry was the I.E.S. dinner and dance which took place towards the end of April. We wouldn't say it was a riot, we didn't eat off gold plate and if wine flowed like water we didn't notice it; nevertheless, it was one of the happiest parties we had been to for a long time. There is something indefinable about I.E.S. members and their social functions; however much they may try to do one another in the eye in their business capacities as manufacturers, sellers or installers, once they get together they cast away the cares of the day and all become jolly good fellows. And this is true of all I.E.S. social functions wherever they may be held about the country. The view of the secretariat we understand is that they have only to get sufficient people together for a party to be a success; they may be nearly right but we can't help thinking that there is a little something which they themselves add and which has some effect on the final result.

"Speeches can, of course, make or mar a dinner. The I.E.S. always tries to keep them short but once a determined speaker gets on his feet there is nothing anyone, other than the speaker himself, can do to speed the programme. At the Cafe Royal, in April, all the speeches were brief and to the point, four of them being delivered within 25 minutes. That isn't bad going; the record was at Harrogate in 1948 when the time for the same number of speeches was 19 minutes, though this was nearly challenged at Southport last year when the first three runners came home in less than 15 minutes. Anyway, full marks to Messrs. Lennox, Eccles, Harper and Creer for their efforts on April 20." — GEORGE J. TAYLOR, *Day-Brite Lighting, Inc., New York, N. Y.*

BOOKS AND PAMPHLETS

Mechanical and Electrical Equipment for Buildings, Third Edition, by Charles M. Gay, Charles D. Van Fawcett and William J. McGuinness, published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 564 pages, illustrated and indexed. $8.50.

This third edition has been extensively revised and expanded and incorporates the theory and practice of the important types of mechanical and electrical equipment for buildings, including acoustical materials and supporting media. Included in Section V on electrical equipment are two chapters on lighting: theory and fundamentals and design of lighting systems.

Interior Electric Wiring and Estimating — Part Two — Industrial, by Kennard C. Graham, published by American Technical Society, 848 East 58 St., Chicago 37, Ill. 324 pages, illustrated and indexed. $4.95.

This is a companion volume to Interior Electric Wiring — Residential. It covers the special problems of electrical installations in factories and other industrial buildings including such specialized subjects as X-rays, electrical heating devices, welders, electric signs and remote-control low-energy wiring installations. Two chapters are devoted to planning and installing non-residential lighting. Direct reference is made to applicable sections of the National Electrical Code as it affects each subject.

Principles of Electric Utility Engineering, by Charles A. Powel, published by John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. and The Technology Press of the Massachusetts Institute of Technology. 251 pages. $6.00.

A review of the business and technical problems facing the electric utility engineers, this book singles out those points basic to the design and operation of a utility. It discusses the financial considerations and government controls, in addition to the technical considerations of energy sources, steam generating stations, generating-station auxiliaries, hydroelectric generating stations, transmission energy and transmission equipment, power system fault control, lightning phenomena and insulation coordination and power distribution.

Outdoor Lighting for Family Living, Bulletin LS-171, by Mary E. Webber and George T. Howard, published by the General Electric Co., Cleveland, Ohio. 28 pages, illustrated.

Prepared for the lighting designer, landscape architect, builder, florist, horticulturist and outdoor and garden enthusiast, this booklet points out the benefits that can be gained by planned outdoor lighting. Subjects treated are: Outdoor Lighting Provides New Vistas for Family Living; What to Light — Developing a Plan; How to Expand the Hospitality and Comfort of Porches and Terraces; How to Reveal the Beauty of Gardens After Dark; Methods of Lighting Flowers, Pools and Trees; How to Increase Play and Work Hours; How to Provide Sure Seeing at Entrances and Walkways; Types of Outdoor Lighting Equipment — Suggested Uses; Wiring; and General Electric Lamps.

(Continued on page 32A)

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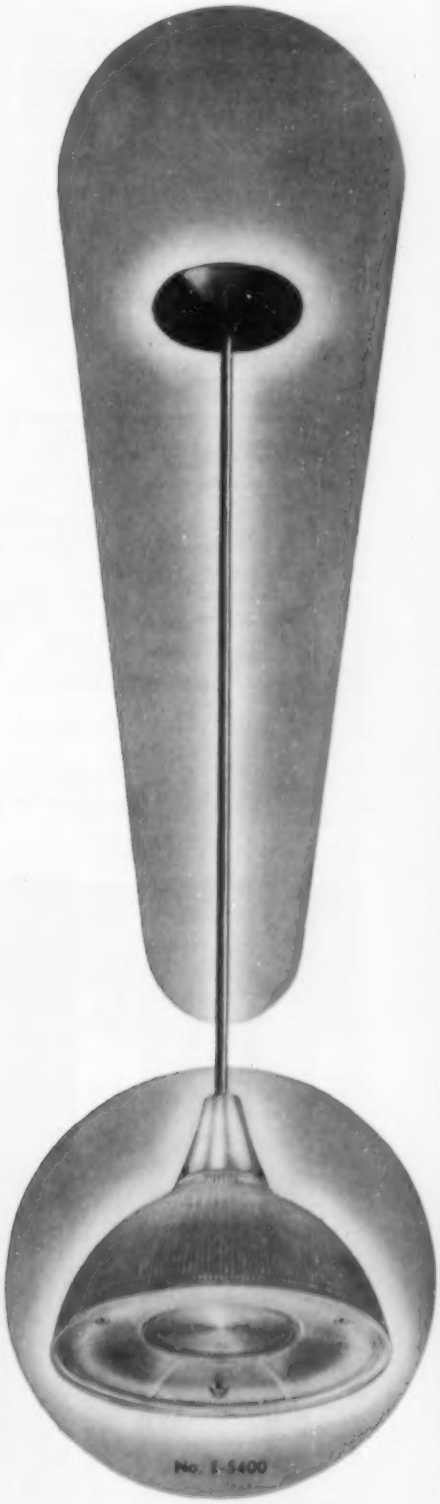

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HOLOPHANE

(Continued from page 30A)

National Directory of Safety Films, an annual publication of the National Safety Council, is a comprehensive listing of motion pictures available from a wide variety of sources for safety education within business and industry, on the farm, in homes and on streets and highways. Brought up to date each year, the directory is available from the National Safety Council, 425 North Michigan Ave., Chicago, 11, Ill. Prices range from $1 for single copies to $.75 each for 1000 or more.

NEW MEMBERS

At the meeting of the I.E.S. Council held at Lake George, N. Y. on June 9, 1955, the following were elected to membership. Names marked * are transfers from Associate Member grade.

ARIZONA SECTION

Member:
*Roberts, D. L., Arizona Public Service Co., Casa Grande, Ariz.

Associate Members:
Foster, P. E., Arizona Public Service Co., Buckeye, Ariz.
Hall, B. J., Arizona Public Service Co., Buckeye, Ariz.
Maurer, B. G., Arizona Public Service Co., Phoenix, Ariz.
Payne, B. G., Arizona Public Service Co., Phoenix, Ariz.

ARK-LA-TEX CHAPTER

Associate Member:
Gardner, R. C., Jr., Southwestern Gas & Electric Co., Shreveport, La.

BRITISH COLUMBIA SECTION

Members:
Ellis, J. A., Canadian Broadcasting Corp., Vancouver, B. C.
Rich, Royce, 2686 W. Broadway, Vancouver, B. C.

Associate Member:
Montaine, A. M., B. C. Fluorescent Sales & Service Ltd., Vancouver, B. C.

CAPITAL SECTION

Member:
Blitz, Murray, Bureau of Ships, Power & Lig. Systems Device Section, Washington, D. C.

Associate Member:
Lowry, R. M., General Electric Co., Washington, D. C.

CENTRAL ILLINOIS CHAPTER

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Blessing, Mrs. Q. G., Central Illinois Light Co., Peoria, Ill.
McCutchen, Mrs. R. R., Central Illinois Light Co., Peoria, Ill.
Shemas, E. G., Shemas Electric, Peoria, Ill.

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Walters, R. B., Corning Glass Work, Corning, N. Y.

CENTRAL OKLAHOMA CHAPTER

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Foutz, B. D., Oklahoma City Board of Education, Oklahoma City, Okla.
Myers, J. F., Wetherbee Electric Co., Oklahoma City, Okla.
Prokup, C. V., Service Electric Supply Co., Oklahoma City, Okla.
Snyder, C. H., Service Electric Supply Co., Oklahoma City, Okla.
Westmoreland, W. P., Service Electric Supply Co., Oklahoma City, Okla.

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Orr, M. D., Advance Transformer Co., Chicago, Ill.
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Gordon, H. A., Gordon Electric Supply Co., Kankakee, Ill.
Lang, D. H., Schmidt, Garden & Erikson, Chicago, Ill.
Pellegrinetti, G. P., S. P., Schmidt, Garden & Erikson, Chicago, Ill.
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Wallace, C. T., Curtis Lighting Inc., Chicago, Ill.

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Biester, R. E., University of Illinois, Champaign, Ill.

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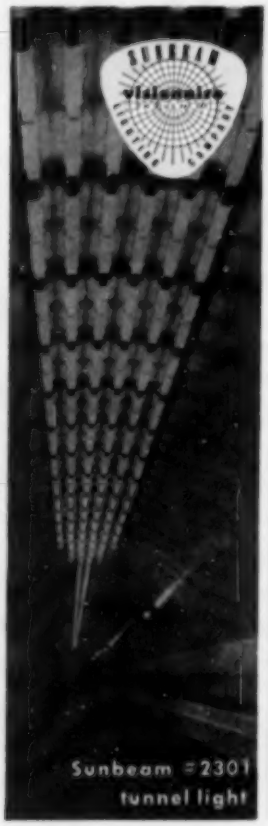
Jenkins, R. C., Ohio Edison Co., Alliance, Ohio.
Marchetti, R. R., Sola Electric Co. Inc., Cleveland, Ohio.
Schneider, L. J., Jr., Westinghouse Electric Corp., Cleveland, Ohio.
Stoltz, R. W., Cleveland Electric Illuminating Co., Ashtabula, Ohio.



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(Continued on page 34A)

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(Continued from page 33A)

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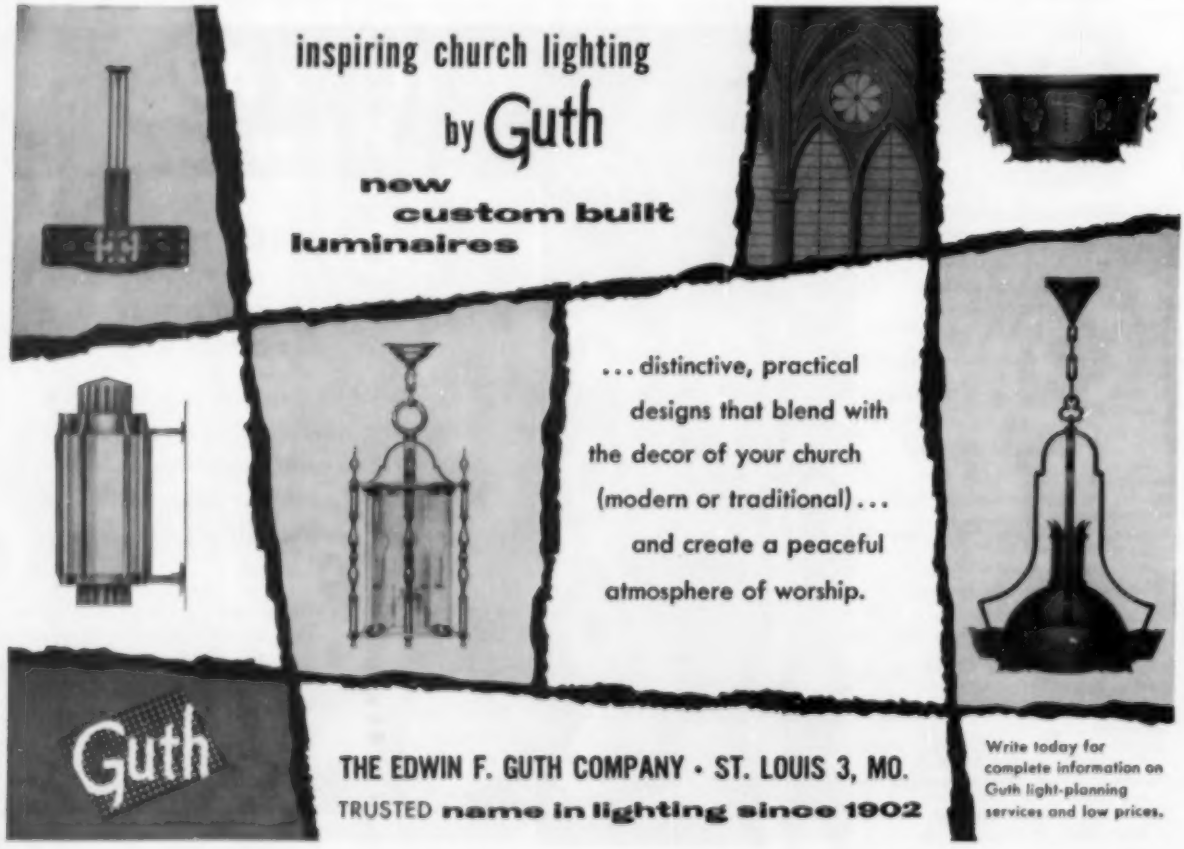

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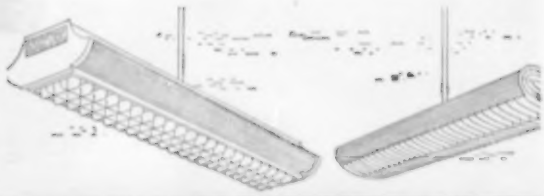

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LAMP LIFE TEST: On the left is the start of a rapid-start lamp life test in the Sola laboratories. Below the lamps are three Sola Constant Wattage Ballasts and a like number of each of three other leading brands. At the right, you see the test installation 15 months later. The six lower lamps are operating from the Sola Constant Wattage Ballasts.

Sola-Ballasted Lamps Still Operating After Exceeding 133% of Rated Life

With rapid-start lamps operating on a continuous cycle of three hours on and twenty minutes off, this test installation provides a convincing comparison of rapid-start ballast performance. Ten months after starting date, four ordinary ballast-operated lamps had failed; and during the 14th month, two more of these were out. Yet — after more than 15 months — every test lamp operating from Sola Constant Wattage Ballasts still provided constant light output and reliable starting. This record of 9,980 burning hours is 33% in excess of rated lamp life.

This longer lamp life provided by Sola Rapid-Start Ballasts is due largely to optimum starting voltage, to a peak-to-RMS ratio of only 1.51, and to the stabilization of current flow through the cathodes.

When your rapid-start lamps operate from quiet Sola Constant Wattage Ballasts, you can expect the same long lamp life plus the other advantages listed below:

RELIABLE STARTING: Sola Ballasts provide 300 volts from lamp to ground with absolute safety.

CONSTANT LIGHT OUTPUT: Incorporation of the Sola Constant Wattage Principle stabilizes light output within ± 2% over the primary voltage range of 106-130v.

LONG BALLAST LIFE: The Sola Ballast is designed with low heat rise as a primary consideration and, when one or both lamps fail, ballast operating temperature is further reduced.

Do you manufacture fixtures? Do you specify, operate, or maintain lighting installations? If so, investigate the advantages of a Sola Constant-Wattage-Ballasted rapid-start system. Write for full information or request a sales engineer to call.

SOLA *Constant Wattage* **BALLASTS**

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CHAMPION *says:*

"Fluorescent lamps are designed to operate at specific electrical values. The use of auxiliary equipment that has been proven to meet these agreed upon standards will assure the user maximum value for his lighting dollar with a minimum of operational failures. Certified Ballasts are inexpensive insurance."

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"The life and light output ratings of fluorescent lamps are based on their use with ballasts providing proper operating characteristics. Ballasts that do not provide proper electrical values may substantially reduce either lamp life or light output, or both. Ballasts certified as built to the specifications adopted by the Certified Ballast Manufacturers (CBM) do provide values that meet or exceed minimum requirements. This certification assures the lamp user, without individual testing, that lamps will operate at values close to their ratings."

SYLVANIA *says:*

"The light and life ratings of fluorescent lamps are based on three hour burning cycles under specified conditions and with ballasts meeting American Standards Association specifications. Ballasts marked with the CBM emblem and certified by Electrical Testing Laboratories, Inc., meet ASA specifications."

WESTINGHOUSE *says:*

"Use ballasts that are tested and Certified by Electrical Testing Laboratories or ones that are otherwise known to meet the specifications of the lamp manufacturer. These will give best results with Westinghouse fluorescent lamps."

That's why CERTIFIED CBM BALLASTS merit the slogan—Tailored to the Tube.

Certified CBM Ballasts are built to assure quiet operation and long trouble-free life.

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60%
TRANSLUCENT, ribbed plastic side-panels for properly diffused, high-quality light for better seeing.
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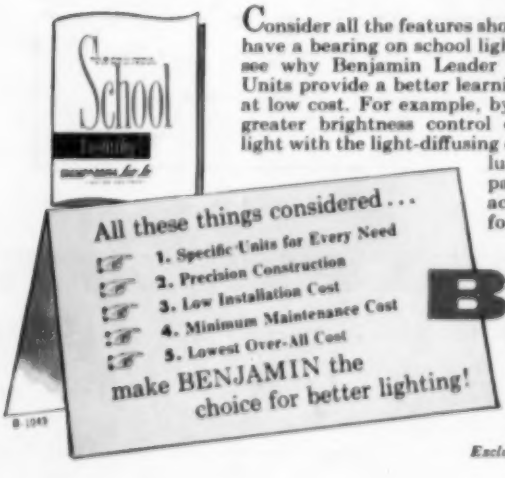
LOUVERS designed for proper lamp shielding, less dirt collection . . . hinged on both sides, or may be taken down for cleaning.

All things considered,
. . . for Low-cost School Lighting . . .
the Better Lighting choice is

Varsity

Consider all the features shown above which have a bearing on school lighting, and you'll see why Benjamin Leader Line "Varsity" Units provide a better learning environment at low cost. For example, by combining the greater brightness control of 40% upward light with the light-diffusing quality of translucent plastic side-panels, "Varsity" achieves high uniformity of illumination with a minimum of harsh ceiling contrasts. That means less eye fatigue and a better visual environment. Yet, because of extremely simple construction, "Varsity" Units are available at surprisingly low cost. For further details on all the things to consider on "Varsity" and the complete Benjamin Leader Line of School Lighting Units, send for FREE SCHOOL LIGHTING BULLETIN. Write: Benjamin Electric Mfg. Co., Leader Division, Dept. I, Des Plaines, Illinois.


School
All these things considered . . .
1. Specific Units for Every Need
2. Precision Construction
3. Low Installation Cost
4. Minimum Maintenance Cost
5. Lowest Over-All Cost
make BENJAMIN the choice for better lighting!

BENJAMIN TRADE MARK
Leader Line
LIGHTING EQUIPMENT

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